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LESSONS

ON

COMMON THINGS.

LONDON AND GLASGOW:
WILLIAM COLLINS, SONS, AND COMPANY.
1876.

PREFACE.

THE following pages have been compiled in order to supply pupils with a suitable text-book treating of the origin, nature, and uses of many things which come daily under their observation, and in regard to which a vast amount of ignorance undoubtedly prevails.

The work may be advantageously used either as a special class-book or as one of the necessary extra reading books. In either case, the meanings at the beginning of each subject will be found of considerable service; and, as many of the lessons treat of food, clothing, and the like, it will be found specially suitable as an additional text-book for girls, or for those, at least, who are studying "Domestic Economy."

The compilation will also furnish to pupil teachers and monitors excellent matter from which to form *Notes of Lessons;* and as every effort has been made to have the information contained correct, teachers generally will find it of much service, by way of reference, in their usual Gallery Instruction.

CONTENTS.

LESSONS ON COMMON THINGS.

RAISINS.

Raisins.—What are raisins? Dried grapes. How many kinds of raisins are there? Three: Valencia, Muscatel, and Sultana raisins. Have they different qualities? Yes; but the first two differ in the process of drying, and in the qualities which arise from the two modes of drying them. How are they dried?

The Valencia raisins, when gathered, are dipped into hot lye, which is made up of wood ashes, oil, and lime. Is anything else done to them? When taken out of the lye, they are spread out on hurdles of wicker-work to dry in the sun. How long do they take to dry? Fourteen or fifteen days. What is done with them after they are dried? They are packed in rows and layers in boxes. Does this mode of drying them affect their quality? Yes. It destroys their natural flavour, and makes their skins less tough.

How are the Muscatel raisins dried? They are dried on the trees. Is nothing done to them? Yes, something is done. When the grapes are ripe, and whilst still on the trees, their foot stalks are cut half through, which stops the flow of the sap from the trees, and the grapes soon dry. The natural flavour of the grape is thus retained, but their skins are tougher than the skins of the Valencia raisins. How are the Valencia raisins used? They are used chiefly in puddings and sweet cakes. How are the Muscatel raisins used? They are eaten at table as a dessert, and along with almonds.

What are Sultana raisins? They are seedless raisins that come from Smyrna. They are much smaller than either the Valencia or the Muscatel raisins, and are entirely used in baking sweet cakes, and in cookery.

FIGS.

Figs.—What are figs? The fruit of a small tree which grew originally in the south-west of Asia. Where does it grow now? All over the south of Europe. How high does the tree grow? About twenty feet. What kind of leaves has it? It has large leaves, which are divided into five parts. They are rough on the upper, but smooth and downy on the under side. How does

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There are two kinds, the sweet, and the bitter almond; but there are three varieties of the sweet and, it is said, that there is no marked difference in either the tree or the kernel of the bitter and the sweet almond, and that one and the same tree, by culture, can be made to produce both kinds. Which of the three varieties of the sweet almond is the best? The "Jordan almond," from Maloza, is the best. It has the largest and the roundest kernel. Which comes next to it in quality? The "Valencia," which has a shorter, broader, and flatter kernel than the Jordan almond. The third variety is generally imported in the shell. It is the smallest of the three. Are these all sweet almonds? Yes. Does the almond nut contain oil? Yes; it contains very fine oil, which is sometimes expressed from the kernels, and sometimes obtained by boiling the almonds in water, when the oil rises to the top, and may be skimmed off. What is the other kind of almond? It is the bitter almond, which is grown in Barbary, in the north of Africa. It is shorter, and thicker than any of the three varieties of the sweet almond. How is the bitter almond used? It is valued chiefly for its oil, but also for the flavour which it imparts to puddings and other articles of food in cookery.

FOREIGN CURRANTS.

Foreign Currants.—What are currants? The dried fruit of a species of vine tree. Is it a hardy plant? No; rains frequently injure or destroy the fruit. When do the trees begin to bear fruit? At the end of six or seven years after being planted. How do currants differ from grapes? They are smaller, and have no stones; but they have an exquisite flavour, and are, when ripe, of a dark, red colour. When do they become ripe? In August, at which time they are gathered, and dried in the sun. Is anything done to them after being dried? They are packed for shipment to other countries. Where were currants originally grown? Around Corinth, and from that circumstance they were called "Corinths"; but this name has since been corrupted to "currants." Where are they now cultivated? In the islands of the Grecian Archipelago. How are currants used? They are largely used in this country in making most kinds of confectionery or sweet cakes.

HOME CURRANTS.

Home Currants. — What are home currants? The fruit of a shrub plant, known as the *genus Ribes*. How many kinds are there? There are three varieties of home currants, the Red, the White, and the Black, and all the three are largely cultivated. Are they the same as the dried currants of the Grecian Archipelago? No; they are of a different kind. They grow on a small shrub about three or four feet high; all the three kinds have stones in the fruit, and they are used chiefly in making jams and jellies. Are they nice or useful? They are both pleasant and salutary in their natural state as fruit, and also in their preserved

state as jelly. They are gratefully acid, are cooling and laxative, and they tend to resist putrefaction. In what cases are they useful as medicine? In cases of fever, and other diseases accompanied with thirst, and dryness of the tongue and throat. Which of the three kinds, the red, the white, or the black, is best for a sore throat? Black currant jelly is said to be very beneficial in cleaning and cooling the throat in cases of cold or even ulceration: but all three kinds have a slightly acid taste, a very pleasant flavour, and both the fruit and the preserves made from it are very wholesome. The leaves of black currants are fragrant.

COFFEE.

Coffee.—What is coffee? It is the seed of a plant which grew originally in Abyssinia; but is now grown largely in Brazil, Central America, the East and West Indies, Arabia, and Ceylon. What sort of leaves has it? They are ever-green, bright and deep in colour, of an oblong shape, and pointed apex. What sort of flowers has it? The flowers are small and white, slightly tinged rose colour. They spread out all over the tree at once, as if wrapped round with a snow shroud, and they fill the air around with a delicious fragrance. On what do the flowers grow? On short foot-stalks, in clusters around the joints of the branches. What are the flowers followed by? By dark red berries, which grow to the size of a cherry. What do the berries contain? Two hard, oval-shaped seeds. When do the trees begin to bear fruit? At the end of ten years; but the fruit is not reckoned good till four or five years longer. How long do they continue to bear fruit? Eighteen or twenty years. On what kind of soil or land do they grow? Chiefly on the high lands, where other grain or pulse cannot grow.

How do they gather the berries in Arabia? They spread cloths under the trees, and then shake the trees, which makes the berries fall. What do they do with them? The berries are dried in the sun, then crushed between rollers to remove the husks, after which the seeds are again dried in the sun, and finally packed for sale. How are they gathered in the West Indies? Negroes pluck them from the trees, and put them into bags. What is done with them after that? Sometimes they are dried in the sun, with the husks on, but often not, and they are put into a mill to remove the husks. How are the seeds made into coffee? They are roasted in a metal vessel, over a slow fire. This makes them lighter in weight, darker in colour, but larger in size. Have they any taste or smell before they are roasted? Scarcely any, and are tough; but after roasting they are crisp, impart a taste, and emit an aromatic odour.

THE USE OF COFFEE.

The Use of Coffee.—How is coffee used? When newly roasted, it is ground to a coarse powder, and boiled, or infused in boiling water. Is anything added to it? Hot milk or cream, and sugar to

sweeten it according to taste. Is it wholesome? Coffee is slightly stimulant, it assists digestion, and affords nourishment to the body or system. What effect has coffee without sugar and cream? It wards off sleep. How do the Turks make their coffee? In a small, conical shaped saucepan, holding about two table spoonfuls of water. They take a dessert spoonful of the berries, roast them, pound them, and put the powder into the pan, which has a long handle, nearly fill it with water, and then they place the conical point of it among the hot coals of the fire. Does this take long to boil? Only a second or two. What is done with it then? The *whole contents* of the saucepan—the coffee as well as the liquor—are poured into a china cup fitting into a brass socket which holds the cup. Do they take anything along with it? No, neither sugar, milk, nor cream. How do the people in France take their coffee? They drink the clear infusion or decoction, generally without cream or sugar, but often with brandy. How do the English people take coffee? They, like the French, drink the liquor only, either the infusion or the decoction—generally the latter—and add milk, or cream, and sugar. What kind of pot is the best to boil coffee in? A broad bottomed pot, with a narrow mouth at top is best, as the aroma does not escape so much during the process of boiling, as it would with a wide-mouthed pot. Is coffee always sold in a pure state? No; it is often adulterated with chicory, roasted beans, roasted peas, and acorns. What are the best means of obtaining pure coffee? Buying the *beans;* and roasting and grinding them at home, just before the coffee is to be used.

Is chicory injurious? No; not to the health, but chicory is much cheaper than coffee, and can be had separately. So the best way is to buy it at the grocer's, and mix some of it with the newly ground coffee, as this is thought by many to improve the flavour.

CHICORY.

Chicory. — What is chicory? The dried and roasted root of a species of plant like the dandelion. How is it used? It is generally mixed with coffee. What object is gained by thus mixing the coffee with it? The coffee gets a better flavour, but its nourishing power is not increased. It gives an appearance of strength, however, as it imparts a deep brown colour to the coffee. How may pure coffee be known from a mixture of coffee and chicory? If some *cold* water be poured into a glass containing the mixture, the chicory will give a dark brown colour to the liquid; but if the coffee be pure, the liquid will remain unchanged. What other substances besides chicory are used to mix with, or to adulterate, coffee? Chestnuts, acorns, saw-dust, and oak bark are used for the same purpose. Can purchasers detect the mixture? Not generally; because, for the most part, they buy it in a ground state. Is buying the "berry" always a safeguard against being imposed upon? No, because spurious "coffee-berries" can be made that are very like the real berry. How are these spurious berries made? They are generally made by machinery.

COCOA.

Cocoa.—What is cocoa? A plant about the size of a cherry tree. The fruit of the tree is also called Cocoa, and so is the liquor made from the fruit. Is this the same as the cocoa-nut tree? No; the cocoa-nut tree is tall, but this is not; it is very like the cherry tree in shape, as well as size. Where does it grow? It grows, without being cultivated, in Central America, on both sides of the equator, but it is now cultivated largely in the West Indies, and in the warmer regions of Asia and Africa. How high does it grow? It grows naturally to a height of thirty feet. What kind of leaves has it? The leaves are smooth, and of the shape of cherry leaves. What sort of flowers has it? The flowers are small, and grow in clusters. What sort of fruit has it? The fruit is a woody pod, seven or eight inches long, three or four inches broad, oblong in shape, smooth and tough, and tapering to a point at one end. What colour is it? The colour varies at different times, being bright yellow, then red, and finally purple. Has the pod a rind? Yes; it is thick and tasteless, and it has five parallel cells in a line from end to end. How many seeds are in a pod? Some have twenty, and others forty, immersed in white pulp, as thick as butter, and of a pink tinge. How are the seeds placed? They are closely packed round the core of the pod. How large are the seeds? About the size of a small bean. Is there a husk on the seed? Yes. It has a thin shell, of a dark brown colour, and brittle texture. What appearance has the kernel? It is of the same colour as the shell, is irregularly divided, but the parts do not separate till the shell is removed. Does the kernel contain oil? Yes; it contains half its own weight of oil, which is got by pressure. Is it for this oil the trees are cultivated? Not chiefly; but for making cocoa and chocolate. When is the fruit gathered? The tree is ever-green, and bears flowers and fruit the whole year round, but the chief crop is got in December. What country produces the best cocoa? Both the best, and the largest quantity, comes from Caraccas, the West Indies, New Granada, Brazil, and Ecuador. How is cocoa prepared for the table? In the same way as coffee. How is cocoa made soluble? By adding starch and sugar to the kernels before grinding them. The starch absorbs the oil, and the sugar renders the starch soluble.

CHOCOLATE.

Chocolate.—What is chocolate? Chocolate is prepared from cocoa kernels. Why is it called *chocolate*, and not cocoa? The name "Chocolate" was given to this beverage by the Mexicans, who spelled the word "Chocolatl." How is chocolate prepared? The kernels are shelled, starch and sugar are added to the cleaned kernels, and the three are ground between rollers upon a hot table. Does this grinding produce a powder? No; the three are formed into a soft, smooth paste, which is made up into cakes or moulded into various shapes. Is this the whole process of prepar-

ıg chocolate? Yes, only some-
mes it is flavoured with vanilla
r cinnamon. Is chocolate ever
dulterated? Yes; in England,

flour and *Castile soap* are used for this purpose. Lard is also ground with the kernels, and the paste is flavoured with spices.

COCOA-NUT TREE.

Cocoa-nut tree.—What kind of
ree is the cocoa-nut tree? It is
species of "Palm tree"—it be-
ngs to that tribe of plants.
Where does it grow? Only in
he warmer countries of the
'orld. Is the cocoa-nut a tall
ree? It has a very lofty stem,
'hich, from its great length, may
e called gigantic. In what coun-
ries does it grow abundantly?
n Ceylon, Siam, the Islands of
he Pacific Ocean, and in Brazil.
Where does it grow best? Near
he sea, which often carries the
uts to other lands, where they
ake root and grow. They often
hus form the first plants that
row on coral reefs. What sort
f stem has the cocoa-nut tree?
ı soft, fibrous stem, with a tuft
f twelve or fifteen leaves at the
op, and each leaf is from twelve
o twenty-four feet long, and
bout three feet broad. Do the
eaves grow on stalks? Yes; and
t the base of each leaf-stalk,
here is a fibrous network sur-
ounding it. Where do the
lowers grow? The flowers spring
ut of slits in the sheaths, hang-
ng on the under sides of the
eaves. How often do the trees
loom? Every six weeks during
he wet season, and thus may be
een at one and the same time,
n one and the same tree, fresh
lossoms, young nuts, and the
ipe fruit. How many nuts will
tree produce? From eighty to
hundred yearly. How long do
he trees continue to bear?
bout seventy years. What sort
f nuts do they bear? The nut is large, the whole being the size of a man's head. It has a hard shell, a white kernel, which has the taste of a hazel nut, is hollow in the centre, and filled with a sweet milk-like juice. Has the shell a husk? It has a thick husk, smooth on the outside, but fibrous on the inside. Is the trunk or stem of any use? The natives of Ceylon build their huts with it, and thatch them with the leaves. They also make doors, windows, tables, chairs, and many other things with its wood. Do they make anything else with it? Yes; their canoes. How do they use the nut? It supplies them with milk to drink, and to mix in their coffee. How do they use the shell? To make cups, jars, spoons, lamps, and other things. How do they use the kernel? They use the oil of the kernel to burn in their lamps, and they anoint their hair with it. Do they do anything with the sap of the trunk? They make a pleasant beverage, which they drink in a fresh state, and which they also boil and evaporate, to obtain sugar, which they call "jagghery." What do they do with the jagghery? They ferment it and distil it to obtain a spirit which they call "arrack." Is this the only use made of jaggery? No; by mixing it with lime, they obtain a powerful cement which resists both water and heat. Do they make anything else from the arrack? Yes; by fermenting the arrack, they obtain vinegar. What do they do

with the leaves, besides thatching their huts? They make buckets and baskets, and books to write on. Is anything made from the leaves? The leaves are burned to get potash. Are these all the uses they make of the leaves? No; they make oars with the mid-ribs, and they make *brooms* and *torches* with the smaller ribs of the leaves by *bruising* their ends, and they make *arrows* and *pens* of them also by *pointing* instead of bruising their ends. What do they do with the fibrous husks? They twist them into cordage, of which they make nets and hammocks.

Are many cocoa-nuts brought to this country? Yes. What do we do with them? Extract oil from the kernels; we steep the husks in water, beat them to remove dust, the outer skin, and all soluble matter adhering to the fibres, which, when thus cleansed, are called "coir"; then the "coir" is made into cordage and cables; it is also made into thread, and woven into door mats, and matting for floors; but the coarsest husks are used as scrubbing brushes, and all the loose fibres are used in stuffing mattresses and other articles of a similar kind.

ORANGES.

Oranges.—What is considered to be the native region of the orange tree? China and the north of India. Where is it now grown? In Africa, north and south, the south-west of Europe, Turkey, the islands of the Mediterranean, South America, the Azores, and the West Indies. Large quantities are grown in Spain, Portugal, and Italy. What size is the tree? It is a small tree. What kind of leaves has it? The leaves are dark green, of a close, smooth texture, and dotted with clear spots, which contain a volatile oil that emits a peculiar odour. What sort of flower has the tree? Delicate white flowers, having a most delicious fragrance. Are there many kinds of oranges? There are several kinds of sweet oranges, besides the bitter orange. Which is the best kind? The St. Michael oranges are by far the best. They have a smooth, thin skin, and they are not so round as the Valentia oranges, but they are flatter at the poles, that is, the diameter measured from the foot stalk to the flower top is not so large as it is measured equatorially. Which kind ranks next to the St. Michael? The Valencia oranges. They are much coarser in the rind or skin, which is thicker also, and their flavour is not so delicious. What are the names of other kinds? There are the blood-red orange, and the small Tangerine or Malta orange, but these are not so well known in this country. Are all these sweet oranges? Yes. Where is the bitter orange grown? In Seville, in Spain. How is the bitter orange used? The rind of it is made into "orange peel," and also into marmalade. The whole pulp of the bitter orange has, however, of late been made into marmalade. How are oranges packed? They are wrapped in maize leaves, and packed in rows and layers in large chests or boxes. When are oranges imported? In December and succeeding months. How long have we a supply? From December till July. Are the oranges brought in

December ripe? No; they are greenish, very acid, and require to be eaten with sugar, but from March till July they are all ripe and sweet. How are oranges used? They are eaten as a dessert at table, and almost by all at any time. They are gratefully acid, and, in feverish disorders, are very useful in quenching thirst, and cooling the system. Are the seeds or rind used? No, neither the seeds nor the white, tough rind should be eaten. Is no use made of the rind? An essential oil is extracted from it, and a tincture is made from the dried rind, and is used as a good tonic, forming, it is said, one of the ingredients of Huxham's bark. Oranges prevent and cure sea-scurvy, and are therefore much used in ships.

LEMONS.

Lemons. — What are lemons? The fruit of one of the four kinds of the citron family of plants, the other three being the orange, the lime, and the citron. Where did it originally grow? At the base of the Himalaya Mountains in India. Where is it grown now? In Sicily, Spain, and Portugal. When was it brought to Europe? About the time of the Crusades. What is the usual height of the tree? About 12 to 15 feet. What sort of petals has it? The petals are of two colours—white inside, and red on the outside. What is the colour of the fruit? Pale yellow. What taste has it? The juice of the lemon has a very acid taste. Has the rind any smell? It is very fragrant. How is it used? It is made into a conserve, and used in baking sweet cakes. What effect has lemon-juice when taken internally? It is very cooling, and it has, like oranges and lime-juice, proved effective in curing sea-scurvy.

LIME-JUICE.

Lime-Juice. — What is lime-juice? The juice of the fruit of the lime-tree, one of the four families of the citron-plant. Is it grown in Europe? No; but the only fruit brought is the small sweet fruit, about the third of the size of a lemon, and it is always brought in a preserved state. What are the shape and colour of the fruit? Oval shaped, and of a pale yellow colour. What taste has it? The pulp has a sub-acid taste, and it is slightly bitter. What sort of flowers grow on the tree? The flowers are white and small. How has the juice of the lime been used? The juice of the lime has been most valuable to the British navy, not only as a specific remedy for, but as a preventive of sea-scurvy, which affected the seamen very badly who were obliged to live much on salted provisions. All vessels, except coasters, are obliged by law to have it in their stores on board ship, and it is served out to the men during the voyage. Is it used in any other way? It is now used also as a summer beverage by itself; and also along with some other liquors. How is lime-juice preserved? It is generally put into bottles along with some oil. What is the effect of the oil? It floats on the surface and keeps the air from getting in and changing the taste.

TEA.

Tea.—What is tea? The dried leaves of a small, evergreen tree or shrub, growing originally in China, Japan, and some districts of India. Tea is also the liquor obtained by infusing the leaves. What sort of leaf has the tea-plant? The leaf is lance-shaped, from two to five inches in length, notched or serrated at the edges; and, in its early stage of growth, is of a bright green colour. In what kind of soil does it grow? It grows best in a light soil. When are the seeds sown? In the middle of April, and they are transplanted in rows, three or four feet asunder. What sort of tree is it? It is like the myrtle-tree in appearance? but it has white flowers, with yellow stamens. It also resembles the wild white rose-tree. How high is it? It grows in some cases six, in others twelve feet high. The trees are often planted and used as hedges. Are all the leaves of the tree equally good as tea? No; the leaves at the top or ends of the twigs are the best. What sort of fruit has the tea-plant? The fruit follows the flowers, is dry, and contains three seeds. When do they gather the leaves for tea? Not till the plant is three or four years old; and they are gathered first in Spring, when the leaves are young, tender, and full of sap; they are gathered a second time about a month later, and they are finally gathered a third time when the leaves are full grown and ripe. Which of these three crops is chiefly imported to this country? The last of the three; and it is this crop also which is chiefly shipped to America. How are the leaves dried? They are put, when gathered, into baskets, and dried partially in the sun and air; but sometimes they are steamed, and then dried on hot plates of iron, or copper, or earthenware, which process shrivels or curls the leaves; but at other times, and by others, they are fully dried over a stove in which charcoal is burned. Whilst being thus dried they are frequently stirred or moved about to prevent them being burned.

How many kinds of tea are there? Two; the black and the green. The black tea is the third or older crop of leaves; when gathered, they are placed in a heap, become heated, like newly-gathered *wet* hay, and their colour becomes thereby much darker. But the green tea is the young leaves gathered in the spring, dried and rolled without being heated immediately after being gathered. Are these teas pure? Both of these teas are pure; and made of leaves from one and the same tree; but they are dried differently on hot plates. But inferior teas are often mixed with other leaves, and dyed with Prussian blue. Adulteration is sometimes carried still further in this country by dealers collecting the leaves of infused tea, mixing them with other leaves, and some real tea, and then colouring the whole to deceive the eye of the purchaser.

Its use.—How is tea used? It is used as a beverage. It is generally infused—that is, put into boiling water to extract the aroma or volatile oil of the leaves, and the other soluble matter contained in the leaves. What is the effect of tea thus infused, and taken into the system? This tea-liquid, if strong, is slightly

astringent; it stimulates the nervous system into action, and wards off sleep; but, in moderate strength, it soothes the nervous system, and gently increases the circulation of the fluids of the body. Does tea contain any real nourishment? There is a substance in tea called Thein, which, it is said, affords nourishment to people who use tea, and to prevent waste of the materials of the body in old people. Have the different qualities of tea different names? Yes; thus—Gunpowder tea is hard rolled; common tea is called Bohea; a better and dearer kind is called Congo; and the best and dearest kind is called Souchong; the tender leaves of the young plants are called Mustsha, which means tea for the Emperor; Green or Hyson is made of any of the gatherings, by drying them differently from the black. In what latitudes does tea grow best? Tea does not grow well in either the north or the south of China, the one being too cold and the other being too hot. It grows best in the three degrees of latitude marked 30° and 33°, which district is called the Tea Country.

BEANS.

Beans.—What are beans? The seeds or fruit of a plant of the pulse kind. Where do they grow? In all temperate climes. Where did they grow originally? They grew in a wild state around the Caspian Sea, and in Persia. How are they raised? From seed, sown annually. How high do they grow? Three or four feet. What sort of leaves have they? The leaves are divided, and called leaflets. What sort of flowers have they? The flowers have a shape resembling the wings of a butterfly. What colour are the petals? The flower leaves or petals are white, with a black spot on the middle, and are so fragrant that the breeze wafted across a beanfield is most pleasing and grateful to the sense of smell. What follows the blossoms? Pods of a dark green colour, externally smooth, but thick, and lined with a fine, soft down, in which the seeds are imbedded. What kind of soil suits beans best? A heavy, clayey soil. How are they sown? They are sown in rows during spring or autumn, by means of the drilling machine, or the dibble, and at a distance, the one from the other, of five or six inches. When are they cut down? They are cut down in autumn, just after the grain has been cut. How are beans used? They are given to horses with bran and oats, and other kinds of food. Is this the only mode of using beans? No; they are ground into meal, and given to cows and pigs to fatten them. Is there just one kind of beans? No, there are several. There are haricot beans and French beans, which come from South America, but these are grown in this country merely for table use. Is there any other kind? There is a large, broad, garden bean, the seeds of which are eaten at table in a green state, and they are much relished. What kind of bean is much grown for ornament as well as use? The Scarlet-runner variety. How high does this kind grow? It generally rises to the height of eight or ten feet. What kind of flowers grow upon it? Scarlet-coloured flowers, from which it takes its name.

PEAS.

Peas.—Where does the common pea grow? In all the temperate climates of the world. Where did it grow originally? In the south of Europe. To what class does the pea plant belong? To the class of climbers. How high does the pea plant grow? Some kinds grow no higher than eighteen inches, but others grow as high as six feet. What sort of leaves have they? The leaves are divided, and the ends of the main stalks extend beyond the uppermost pair of leaflets. What is the object of that? These slender tendrils twist or turn round spirally, take hold of any object near, and cling to it for support. Why do they do that? Because the stems are too weak to bear up the leaves, flower, and fruit as an independent plant. What sort of flowers have they? The flowers consist of five petals having the shape of a butterfly's wings, yet they are all different in size and shape. What follows the flowers? Pods. What sort of pods have they? The pods are long and narrow, shaped like some shells, and, when ripe, open and divide into two parts, each half of the pod having half the row of seeds attached to it. What sort of seeds do the pods contain? Each seed or pea has two lobes joined close together at their flat sides, and covered with an outer, white, thin skin. Are there many varieties of peas? Yes, there are several, which differ in shape, size, and colour, as well as in the length of time required to ripen them. What kind of soil do peas require? The white garden pea grows on a light, dry soil, but the grey or common pea grows best on a rich, heavy soil. How are white peas used? Split peas, and pease meal or pea flour, are products of the white or garden pea, and are used to make "pea soup," pease brose, and puddings, which are all both wholesome and nutritious. How are grey or common peas used? They are given to pigs, pigeons, and some other animals, and they are grown in the same manner as beans, but only in some cases are they sown in drills, in others they are sown broad-cast over the field. How do they grow in such cases? They grow up and spread along the ground, but they have sometimes a few beans sown along with them for support. How is pea-straw used? Dried pea-straw is given to both horses and cattle as food; they not only like it, but thrive well upon it. What is done with the shells of the pea-pod? They are sometimes, though not often, made into a kind of spirit. How did the pea get its name? It was so named after Pisa, a town in Italy, where at a very early date peas grew in abundance. When was the plant first grown in England? About the year 1500. When did it begin to get common? About the reign of Queen Elizabeth or the close of the sixteenth century. When was it cultivated first in Scotland? About the beginning of the fourteenth century. Whether does the bean or the pea contain most nourishment? There is not much difference between the two, but the bean stands first in this respect. Where are peas often raised in hot beds? In the neighbourhood of London. Why is an effort made to raise them early in that district? Because for early peas a very high price can always be had in the London markets.

WHEAT.

Vari'eties, kinds.
Tem'perature, degree of heat.
Del'icate, tender, not easily grown.
Econom'ical, cheaper.
Affec'tion, disease or blight.
Rem'edy, cure.

Wheat is grown largely in the south of Russia, in Germany, France, and Austria, the British Isles, the United States, and Canada, in Egypt, and North Africa, and Australia. There are many varieties of wheat, but the most important are the spring and the autumn wheat. Spring wheat is sown in the early spring, generally in April, and the autumn wheat in September or October. The ear of the spring wheat is less thick and strong, but bearded. The grain is smaller, the produce less, the plant less hardy, and there is much less of it sown or cultivated. Winter wheat is stronger than spring wheat, it has no beard, and it bears the changes of temperature well, being a very hardy plant. There are two kinds of it, the red and the white. The red wheat is the hardier of the two, and is well fitted for heavy, cold, clayey soils. It lies in the ground all through the winter. The white wheat is better fitted for light soils, as it is altogether a much more delicate plant. Wheat is sown broad-cast by the hand, that is, the sower walks along and throws handfuls of seed, scattering the seed on the ground as he goes along, and it is also sown by the drill or sowing machine. The latter mode is more regular and economical. Each seed sown, when it grows, produces several stalks, generally five or six.

Mildew is very hurtful to wheat. This affection is called *smut* or *black mildew*. It attacks the grain during the process of ripening, but the seed is generally affected by it before it is sown; and a few grains so affected will spread the affection among a large quantity of the seed. A remedy, however, has been found. This may now be, and is, prevented by steeping the seed in a strong solution of salt or brine, in blue vitriol or sulphate of copper, or in a weak solution of arsenic. Wheat is ground into flour, and that, again, is baked into bread. Wheaten bread is called the "staff of life," because it is used by most nations as their principal article of food. The flour when mixed with water is called *dough*. Salt and barm are added, and the bread when baked is light, spongy, and nourishing; but bread having the wheat when being ground *unsifted*, that is, ground as it grew with the inner husk on, makes the most nourishing and wholesome bread.

OATS.

Indig'enous, native to.
Nutri'tious, nourishing.
Protec'ted, guarded.
Extern'ally, on the outside.
Rel'ish, like much.
Chopped, cut into small pieces.

Oats are not known to be indigenous to any country. This kind of grain is very hardy. It grows in the more northern countries, and even in the higher regions of mountainous countries.

In Scotland, much more of it is grown than barley or wheat. Great heat does not suit it. In hot summers, or in hot countries, it grows husky, and is not so nutritious. It grows thus even in the south of England. There are several varieties of oats—the red, the white, and the black; but the variety that is best liked, and is most largely grown, is called "potato oats." This kind was found accidentally growing upon land that formed a potato heap.

Oats are sown broad-cast in March or April. Four, five, or six bushels of seed are sown on an acre of land, and the produce obtained is about fifty bushels. The stem of the plant is tall, slender, and hollow, but jointed to strengthen it, and protected externally by a flinty varnish of silica. The leaves spring from the joints of the stem, alternately from each opposite side, and so as to balance the stem in its erect posture. They are long and taper to a point, and their veins extend along in parallel lines. When the plant grows up, the flowers appear at top encased in a leafy sheath that opens on one side, and the stem or stalk hangs so that the sheath forms a hood for the flower to protect it from rain, the open side being towards the ground. This sheath is the uppermost leaf of the plant. The blossoms are green at first, but as the grain ripens they become yellow. Each blossom encloses a seed or grain, and all the grains growing on one stalk are called an ear of corn. Oats, kiln-dried and coarsely ground into meal, form a diet both wholesome and nutritious. The people of Scotland like to make this meal into porridge, brose, and cakes, which they relish, and upon which they grow tall, fat, strong, and fresh-looking. In England, oatmeal is not much used as an article of diet.

When the outer husks are ground off the grains are called groats, pronounced *grits*, and gruel is often made from them; but in Scotland gruel is made from the meal, by pouring from a pint to a quart of boiling water upon a table spoonful of the meal, and then pouring off the liquid, and boiling it. The chief use made of oats is in feeding horses. The seeds in a whole state are often given to them, but they are sometimes crushed before being given; and they are more nutritious when given crushed. They are also used for feeding hens, ducks, geese, and other poultry.

The husks of this grain are called *chaff*, and are used in Scotland to stuff beds, being cheap, soft, and very elastic. The ripe straw is chopped for fodder, being reckoned very nutritious for cattle, and is therefore preferred to any other kind.

Oats used to be cut down by reaping-hooks. By and bye scythes were much used; but now, when the nature of the ground will permit of it, the crop is generally cut by reaping machines drawn by one or more horses. Other similar crops are cut down in the same way, as this method is not only quicker but in the end much cheaper, more particularly in the case of large farms, where otherwise a very large number of hands would be required for the purpose. Moreover, in some districts, labourers are not easily obtained, even at excessive wages.

BARLEY.

Affec'ted, changed or injured.
U'niform, all the same.
Converts', changes.
Sol'uble, able to be melted.
Fermen'ted, heated.
Pal'atable, nicely-tasted.

Barley is not known to be indigenous to any country. It is grown largely both in England and Scotland. Early or winter barley is sown in October; but the late or spring barley is sown in March and April. The spring is hardier than the winter barley, and it can be grown easily in the northern districts of Scotland. It is not much affected by extremes of heat or cold, and is thereby fitted for soils totally unfit for wheat. It grows quickly, and ripens soon, so that much less time is required for it than for wheat. It may be the last sown, and yet the earliest reaped of all the grains. Two crops are grown in warm countries; one, the winter barley, sown in autumn, and reaped in spring, and the other, the spring barley, reaped in early autumn. Barley is usually sown after turnips, or other green crops; in some cases, broadcast, and in other cases, in rows by the aid of the drilling machine. Much rain softens and beats the crop down to the ground, where the grain lies and sprouts, and becomes useless. It grows and ripens best in dry weather. Each grain has a long awn, and is in shape a double cone, with a groove on one side between them. The length of the seeds is nearly uniform. Advantage was taken of this to give a name to a threefold division of the inch, as three seeds extending in a line were thought to be an inch in length; so each of the three parts was called a barley-corn.

The chief use of barley is to make malt. It is steeped in water to soften and enlarge it, and, when this has been effected, it is removed and drained, but left in heaps. Forty hours in this state make it send forth its roots, as if it were in the earth, then the maltsmen check the growth by spreading it out on the floor to dry, and afterwards by drying it still more in a kiln. The germ roots are separated from the seeds by treading on the malt, and sifting it. These are called *dust* or *culm*, and are used to feed sheep, but are used also as a manure. Malting converts the grain into a sugary starch, which is soluble in water; and this, fermented, is separated into alcohol and carbonic acid gas; so that 100 parts of both make 57 of alcohol, and 43 of carbonic acid gas.

Barley meal does not make very palatable bread. It is dry and coarse, and soon becomes sour. But much barley is used in making broth and milk porridge. When barley is intended to be used for these purposes, it is husked in a mill, and sold as pearl-barley. The making of pearl-barley is said to be a German invention. In Scotland, the peasantry used to make it by means of hand-mills, but many persons got rid of the husks by stamping the grain in mortars. This grain is also used to feed poultry, pigs, and other animals. The straw is used as fodder for both horses

and cattle, and for this purpose barley and clover are both sown together, and both cut down together. From barley-straw a yellow-coloured paper can be made. Some years ago this manufacture was attempted on a large scale, but without success.

RYE.

Orig'inally, at first.
Procure', obtain or get.
Depreda'tions, plunderings.
Access'ible, able to be got at.

Rye was found growing originally in Tartary, Candia, and around the Caspian Sea; but it is now grown even in the Orkney Islands. It grows on soils poorer and lighter than any other kind of grain. It is grown largely in Flanders and in the north of Europe, where it is much eaten with a little mixture of other kinds of grain. It requires little tillage of the soil, and less manure than either wheat or barley. Rye is sown in autumn, usually after wheat. In Russia, meal, ground from rye, is used by the poorer class of the people; and it is so used also in other countries on the continent. It is made into a dark coloured, coarse bread, not very palatable. In Holland, rye is fermented and distilled to procure a spirit. The straw of rye is used for thatching, and it is also plaited and made into hats and bonnets.

In this country, rye is seldom used as food; but the plant is grown, and cut when green, to feed cattle and sheep, as it can be had before clover or other green crops. It is sometimes sown as a border or fence round other grain crops, to protect them from the depredations of poultry, where the fields are accessible to them. The poultry do not like it, and keep away. Rye is very much subject to disease, which renders it unfit for human food. In such a case the grains become larger and somewhat curved. It is then called spurred rye, or ergot, from which we get a valuable medicine.

RICE.

Infe'rior, of less worth.
Marsh'y, damp.
Sim'ilarly, in the same way.
Li'able, subject.
In'jury, damage or hurt.
Diges'ted, changed into nourishment.
Di'et, food.

Rice grew originally in Asia. There it is still found in a wild but inferior state to the varieties of the plant found under cultivation. Rice grows only in hot countries. It is now grown largely in China, India, Burmah, and Java, and also in Africa, Central America, the southern states of North America, and the West Indies. Rice grows best in hot, marshy lands, as it requires a great quantity of both heat and moisture to bring it to a state of perfect ripeness. The mode of cultivating it in America is as follows:—The seed is sown in trenches 18 inches distant, and

water is then run into and over the trenches, and the fields are kept in this state for several days. More water is supplied when the plants have grown up three or four inches, and this is continued for about two weeks. Then, shortly before the grain is ripe, the fields are again over-run with water, and kept in that state till the grain is quite ripe. When the rice is to be cut down, the water is run off, and the grain is cut with the sickle. When engaged in cutting the rice, the feet of the reapers sink deep into the soil, and this renders the occupation neither pleasant nor healthy. The reaping is, therefore, left in America almost entirely to the negroes.

The largest and best variety of rice has been grown in Carolina, and it is always dearer than other varieties. Rice is cultivated similarly in the warmest countries of Europe. Two crops a year are obtained in India; and three bushels of seed, it is said, will produce fifty, even in Europe, so that the produce must be larger in Asia.

Rice, in its brown husk, is called *paddy*, but when the husks have been removed by partial grinding between millstones, it is called *clean rice*. This process does not crush the seed. Rice is best imported as paddy, as it is less liable to injury, and can be better cleaned in this country.

More people live upon rice than upon any other vegetable production. The inhabitants of India cook it with curry powder, which is a mixture of various spices, and make it their chief article of diet.

It is also the principal article of food in China and other countries in the east. No less than one hundred millions of people are said to live chiefly upon rice.

Rice sits lightly on the stomach, is easily digested, and very wholesome. As rice is not quite so nutritious as maize, wheat, oats, and some other grains, on account of its containing more starch and less gluten, more of it requires to be eaten; but the best way of using it is to make it form only a part of a meal, by taking it along with something else.

In India arrack is distilled from fermented rice, and large quantities of starch are made from it, whilst the straw is plaited and made up into bonnets.

MUSTARD.

Cru'ciform, in the shape of a cross.
Poun'ded, beaten into powder.
Mor'tar, strong vessel used for pounding.
Ac'rid, hot or biting.
Pun'gent, sharp and piercing.
Vol'atile, going off easily in vapour.
Fla'vour, to make more pleasant.
Stim'ulate, to quicken.
Emet'ic, something to cause vomiting.
Op'erates, acts.
Adul'terated, mingled or mixed with.
Infe'rior, of less value.

Mustard grows without cultivation in England and throughout Europe. There are two kinds, the *white* and the *black* mustard. They are so called from the colour of their seeds. They are both herbaceous annual plants. The black grows three, but the white mustard only about two feet high. The blossoms of

both kinds are yellow, and consist of four cruciform petals. The black mustard has a rougher stem and lower leaves than the white, and the seeds are round, and of a dark brown colour.

The white mustard has a smoother stem, smoother leaves, and the seeds are larger, and are paler in colour than the black mustard.

Mustard seed is sown in March or April. When the plants have grown a few inches they are thinned. The crop is gathered in August and September. The seeds are bruised between rollers, and pounded in mortars, to separate the husks, and are then ground to flour.

Mustard, having a very acrid, pungent, volatile oil, is used to flavour food, and to stimulate the flow and action of the gastric juice in the stomach. Hot water mixed with the flour, and made into a paste excites the action of this oil, which is not at all active in the state of powder or flour. Mustard is good taken in small quantities, but in large is injurious, being too irritating. Taken to the extent of one or two teaspoonfuls in warm water, it is one of the readiest and most useful emetics in cases of *vegetable* poisoning. It operates quickly and safely. When applied to the skin as a poultice it produces redness and great irritation, drawing the blood from the internal organ near it, and under irritation or inflammation, and thereby giving relief.

White mustard is sometimes used as a salad when the plant is young, and about two inches high. Mustard is sometimes adulterated with other inferior grain, husks of seeds, and dusts of various kinds.

MAIZE.

Cul'tivated, tilled.
Resem'blance, likeness.
Us'ually, commonly.
Protec'ted, kept safe.
Projects', shoots out.
Aid'ing, helping.
Pre'ference, choice.
Compete', come into opposition.
Nutri'tious, nourishing.
Reck'oned, thought.

Maize or Indian Corn is found growing naturally in America. It is now cultivated in the warm countries of the south of Europe, and in North Africa, but its cultivation does not succeed in the northern and colder portions of Europe. Indian corn has no resemblance to the corn grown in this country. The stem is much stronger, and more jointed and reedy.

It grows as high as ten feet, and is seldom found below seven. It has broad leaves, which cover it in alternate layers. A bunch of flowers or "tassel" grows at the top of the stem. The ears, usually limited to three, are lower down, and protected by a sheath of thin leaves. The ears are called "the cob," which is in the form of a cylinder, and which has the seeds growing on it closely packed in rows. A long filament grows up from each seed, and projects through the top of the sheath. The "tassel" forms a feeder to the grain, and after aiding in the feeding and the ripening of the seeds, dries up and falls off. Maize is sometimes white in colour, sometimes a beautiful yellow, and sometimes a dark red

or chocolate colour. The seed is sown in rows, three feet apart, but it must not be sown too early, or the frosts of cold countries will destroy its growth.

Indian corn forms the chief article of food in many parts of the United States of America, throughout all Mexico, and it competes with rice for the preference in Africa. The growth of maize is so abundant and profitable, that no other kind of grain can compete with it. It is cheap, pleasant, wholesome, and nutritious. It is more oily than all other kinds of grain, and it contains less starch and more gluten than wheat. It is reckoned to be very fattening. It does not make good bread by itself, but it does so by being mixed with wheaten flour. It makes excellent cakes, porridge, and puddings. "Corn flour," the very finest of the grain, is now much used in this country for custards and puddings, and other table dainties.

CHARCOAL.

Smoul'ders, burns slowly.
Comple'ted, finished.
Reduc'ed, changed.
Con'sequently, therefore.
Prefer'red, chosen.
Brit'tle, easily broken.
Indestruc'tible, cannot be destroyed.
Struc'ture, formation.
Dissolve', melt.
Infus'ible, cannot be melted.
Emits', gives out.
Invis'ible, not able to be seen.
Absorbs', sucks in.
Put'refying, decaying.
Ingre'dients, elements.
Preserve', keep for a time.

Charcoal means half-burned, or charred wood. Charcoal is made by cutting the branches of trees into certain lengths, splitting the thicker branches, but not those of six or less inches in diameter. When so cut they are placed on their ends, and piled into a large heap, and covered with turf or earth. A hole is left at the top, and several holes at the sides in order to aid the kindling of the pile. The whole is set fire to at the bottom, and, when well kindled, the hole at the top is closed, and when fully kindled the holes at the sides are also closed. The flame of the pile is thus put out or extinguished, and the wood smoulders on till it becomes red hot, after which it is left to cool, and the charring is thus completed. Wood burned in the air, with a supply of oxygen gas, burns with a *flame*, and is reduced to ashes; but burned without air or a supply of oxygen, and consequently with *no* flame, it is reduced to a state of *char*. Beech wood is preferred; it makes the best charcoal.

Wood charcoal is a black, brittle, porous, light solid, which is indestructible. The annual rings and structure of the wood are left quite marked and distinct on the char. Charcoal can be easily reduced to a coarse powder, having very hard particles. The air does not change it; water does not dissolve it; and even the strongest acids have no effect upon it. If put into fire it remains infusible, but heated to redness in the air, where it is supplied with oxygen, it consumes away without smoke, but emits an invisible gas, called carbonic acid gas, which is a most deadly poison. Charcoal is

very bad conductor of heat. It absorbs gases to a large extent, and is on that account one of the best means we possess of absorbing or removing the bad smells or odours given out by putrefying animal bodies or substances. Charcoal is used as fuel, chiefly on the continent. It is one of the ingredients of gunpowder, but for this purpose the char of the black alder tree is preferred. Charcoal is used to preserve flesh meat in a fresh state, which it does for a long time. It is used also to filter and purify water. Bones heated to redness in close vessels make *animal charcoal*, which is used largely to "clarify," or *refine* sugar.

CORK.

Spe'cies, kind.
Com'merce, trade.
Trunk, thick or main part.
Inser'ted, placed in.
Bulk, space.
In'jure, hurt.
Elas'tic, having the power of springing back.
Imper'vious, not letting in.

Cork is the bark of a species of small, evergreen oak, which grows in the north of Asia, the south of Europe—particularly in Spain, Portugal, and France—and in the north of Africa. Large quantities are grown in Valencia and Catalonia. If left to its natural state, the cork tree sheds its bark every 12 or 15 years. Commerce, however, demands a large and more frequent supply than the trees naturally afford. The bark is therefore cut horizontally round the circumference of the trunk of the tree, just under the branches, and another similar cut is made near the ground or root of the tree. Then several perpendicular cuts are made between the two already formed. A blunt instrument is then inserted between the inner and the outer bark, and the latter is thereby peeled off the trunk. Great care is taken not to injure the inner bark, as such injury would cause the destruction of the tree.

The barking of the trees is performed in July or August, and is repeated at intervals of eight years or thereby, for more than a hundred years. The bark improves with the age of the tree. It becomes softer, freer from pores, and much finer in texture. When taken from the tree, the pieces are large, just the size of the cuts made, and are in the form of oblong arcs. The pieces are put into pits one above another, and flattened down with heavy weights. Water is run into the pits to make the cork yield more readily to the weights. After lying there some time, the cork is removed, dried before a fire, which is allowed to char it on the surface, and when removed, it remains almost flat, and the pores are closer.

Cork is light, easily squeezed or pressed into less bulk, but is also elastic, and impervious to liquids. These qualities make it very suitable to stop bottles, keeping the air out, and the liquids in. Jackets, life buoys, life-boats, floats for nets, inner soles for boots and shoes, and some other things, are made of cork. Broad knives, frequently

sharpened, are used to cut cork. Corks are differently cut from bungs for barrels. The one has the fibre of the cork *across*, and the other *perpendicular*. Corks are therefore less porous in the direction of their length, the reverse is the case with bungs.

OAK BARK.

Exten'sively, greatly.
Impor'ted, brought from other countries.
Conver'ted, changed.
Astrin'gent, binding or strengthening.
Prevents', hinders.
Dissol'ving, melting.

Oak Bark is extensively used in the process of tanning hides for leather. The trees are felled in the spring of the year, just after the sap has ascended to the branches and the leaves. The bark is then more easily separated from the trees. The barkers make incisions or cuts across the stem, about two feet distant, and then peel the bark off in broad flakes. Sticks are driven into the ground about six feet from each other, and young branches laid across the sticks or stakes, as a support for the bark in drying. The separate pieces of bark are laid slopingly against these stakes, and are so left to dry; and in drying, the edges of the bark curl round. The bark is taken away when dry, and stacked like hay, and thatched with straw. Imported bark does not come in such large pieces as our own native bark is cut into; they are not more than three inches long. The bark is torn into small pieces, by means of iron rollers toothed for the purpose, before the bark is used in the tan-pits. This makes the extraction of the tannin from the bark much more easy. Tannin or tannic acid, which exists not only in the bark, but in all parts of the oak tree, is the astringent principle which changes the skins of animals, and forms them into leather. The tannic acid acts upon the skins, and prevents their putrefaction or decay, and also prevents water from dissolving them. The hides are thus converted from skin into leather. Other substances than oak bark are also used to tan skins. Acorns are so used. Valonia, a prickly cup grown in Syria, and Divi-divi, the seed pods of a South American tree, of the leguminous kind, are also used.

CANES.

Profu'sion, plenty.
Flex'ible, easily bent.
Admit' of, allow.
Ascen'ding, going up.
Whole'some, healthful.
Rel'ished, liked.

Canes are a species of the palm tree. They grow without cultivation in the East Indies, in Malay, Borneo, Sumatra, and other islands of the Asiatic Archipelago. Canes have long jointed stems. Some of the species grow a hundred feet high, and others six hundred feet. This is the greatest height of any known tree. The canes grow up among the other trees of the forest in great

profusion, and shoot up their tall, slender, tapering stems far above them all, and swing and bend backwards and forwards in the breeze like elastic twigs. The stems are quite smooth, and even polished, except at the joints, from which the leaves spring all round the stems, and bend backwards in the form of a hook. From the joints also, prickles grow in the form of strong hooks, and both these and the hooks of the leaves enable the stems to climb among, and on to, the top of the other trees, and thus support themselves to a height which otherwise they could not do.

The canes are cut down by the people who live where they grow, and their leaves stripped off by pulling them through a narrow cutting made in a tree for the purpose, and they are then dried in the sun, after which they are tied in bundles. In this state they are shipped to other countries. It is said that about twelve millions of canes are brought to this country, of the value of about twenty thousand pounds. The stems of the canes are composed of woody fibres, and are tough and flexible. They have many open tubes in the interior to admit of the sap ascending rapidly to the leaves, where great evaporation takes place. The stems are also covered with a thin, hard, flinty varnish, that gives them the appearance of being highly polished. They are easily split up lengthwise. They are used in making seats for bedroom chairs, and other lattice or wickerwork. Those canes are reckoned to be the best that are long, thin, and flexible, and of a pale yellow colour, that bend easily without cracking the outward varnish or glossy covering. The canes in an unsplit state, are also much used in making baskets. Canes yield fruit which the natives eat, and when the stems are cut across, a wholesome sap flows from the cut end, and is very refreshing. When the young shoots of the canes are cut off, and cooked, they form a pleasant article of food, which is much relished by the natives.

COTTON.

Vari'eties, kinds.
Resem'ble, are like.
Ab'solutely necessary, cannot be done without.
Improve', get better.
Trian'gular, having three corners.
Fi'nally, at last.
Adhere', stick to.
Ap'ertures, openings.
Succeed', come after.

Cotton is a soft down, produced in the capsules or pods of the cotton plant. There are many varieties of the cotton plant. Some are very small plants, not more than two feet high, and belong to the class of herbs. Others belong to the class of shrubs, and resemble currant bushes. But others still belong to the class of trees, and grow to a height of twenty feet. Cotton is grown in India, China, the United States, the West Indies, Africa, and in all parts of the world where there is sufficient heat. It does not require a rich soil, but sunshine and dry weather are absolutely necessary to its successful cultivation. The seed is sown in holes during the spring months. When the plants grow

up, which they do in a few days in showery weather, they are weeded and pruned. They yield fruit in seven or eight months, and continue to improve for a few years, after which they require to be renewed. The leaves are of a dark, green colour, and divided into five lobes. The flowers are large, of a yellow colour, and have a purple spot, close to the stalk of each petal. They have a double calyx, cleft into three parts, and they appear in July and August. The capsules or pods, which succeed the flowers, are of a triangular shape, about the size of a walnut or small apple, have three cells, and contain the seeds embedded in the cotton down. As the seeds ripen, the cotton swells out, and finally bursts the pods. The seeds are rather larger than the seeds of grapes, and in some cases adhere firmly to the cotton, but in others, as the sea island cotton, grown in Georgia, they are merely embedded in it. The crops are picked in November and December, but the rainy season produces a second crop picked in March and April. Cotton is generally white, but there is a kind grown in China of a yellow colour, which is woven into cloth called *nankeen*. Women and children gather the cotton when ripe, pick it out from the pods, along with the seeds, and spread it to dry in the sun. When dry, the seeds are removed. They are separated from the cotton by a gin, that is to say, the cotton wool is drawn from the seeds, either by parallel rollers which press back the seeds, whilst they draw forward the cotton; or by circular saws having curved teeth which catch the cotton in a box and draw it from the seeds through the apertures of parallel wires placed about the eighth part of an inch asunder. The cotton is afterwards hard pressed in bags, called "bales," as we see it brought to this country. An acre of ground is said to yield 400 lbs., but the yield of sea island cotton is only from 150 to 250 lbs. The wild cotton tree grows to a height of a hundred feet by twenty-five, and spreads out branches covering, in many instances, a space of about 160 feet and upwards.

FLAX.

Fab'rics, stuffs or materials.
Cul'ture, raising.
Suppor'ted, kept from falling.
Extract', draw or squeeze out.

Flax is the fibre contained in the stem-bark of the genus *Linum*. From this are made sail cloth, tarpaulins, and ropes. Flax grows well in the bogs of Ireland, and has been called the *bog lily*. It is also grown in Devonshire, in England, and in the valleys of other countries. The largest quantity of the flax used in England and Ireland is imported from the Netherlands, Germany, Russia. All our fine fabrics are made of the flax imported from the Netherlands. Flemish flax has a slate colour, German flax, a deep brown, and Russian flax, a light brown colour. They are made white by being bleached.

The flax is an annual plant, with a slender green stem of the herbaceous kind, and grows to a height of about two feet. It has

small, narrow, pointed leaves, but without leaf stalks. The flowers are blue, of a beautiful shape, and grow at the top of the stem. These are succeeded by seed vessels, which are round or globular, and contain ten flat seeds, of a dark brown colour, and of an oblong shape. The seed of the flax is either ground into meal, or pressed to extract its oil, which is very valuable. When the fibre of the plant is the chief object of its cultivation, the seeds are sown much more thickly than when the seed or fruit is the chief object in view. When sown thickly, the plants grow higher, being supported by each other. The plants are pulled up when the leaves fall off, which they do when the plant is ripe, and the stem turns yellow. They are carefully dried in the sun, built up in stacks, and covered, to keep them from being wet. Or, if wanted at once for use, the stalks are drawn through the teeth of a coarse comb to separate the seeds, the teeth of the comb being too close set to let them pass through. When the stems have been separated from the seeds, they are steeped in pools of water, until the soluble part of the bark is loosened from the fibres, which then separate easily from each other. They are again dried in the sun and air, being spread on the grass for about two weeks.

The woody part of the stem, which the steeping and drying have made brittle, is then taken from the stalks by a brake. This consists of two pieces of wood, the one, having a slit in it from end to end, and the other, having a notched slip, also from end to end, to fit loosely into the slit of the other. Three of these are usually employed at once on the same stalks or stems. When a bundle of flax is laid across the pieces with the slits, the other pieces are forced down upon them, and the two together bend the stalk, and thus break the woody matter of it, and so render it removable, by beating them with a staff, or by rubbing them between the hands. After this, the flax is heckled, which brings the lengthy fibres all into a parallel direction, and removes those which are too short for use. The heckle is like a brush of pointed spikes or needles fixed on a stand. A bundle of flax is put on the spikes and drawn through them. The long fibres are drawn through the spikes or card, and the short ones are left on the heckle, and they form what is called *tow*. A great deal of this work is now performed by machinery. The flax is now ready for being spun. The spinning used to be performed by women, but it is now done also by machinery. Dundee, in Forfarshire; Dunfermline, in Fifeshire; Barnsley, in Yorkshire; and Belfast, in Ireland, are the chief seats of the flax industry. The Irish grow a large quantity of their own flax, whilst the Scotch import theirs from Germany, and the other countries on the Baltic sea. The English trade in flax is of more recent origin, and it is still of much less extent than either the Scotch or the Irish. China-grass, a species of nettle, yields a woody fibre less durable, but at the same time less costly than ordinary flax. From it large quantities of linen-cloth and numbers of handkerchiefs are now produced. Articles made of this tissue occupy the medium place, as regards quality and price, between those made of silk and cotton.

HEMP.

Orig'inally, at first.
Ser'rated, out and in like the teeth of a saw.
Nutri'tious, nourishing.
Express', squeeze out.
Emits', gives out.
Offen'sive, disagreeable.
Flex'ible, easily bent.

Hemp is an annual plant of the same kind as the nettle, which it resembles. It is thought to have grown originally in the East, but it is now raised in most parts of the world. When grown for its seed it is sown in drills apart from each other. The stem grows straight, five or six feet long, without branches, but leafy at the top, and each leaf is divided into numerous leaflets, which are narrow, pointed, and serrated. The hemp-plant is rough, being covered with hair-like bristles. The flowers, which are green, are either barren or fertile — the former growing on the male, and the latter on the female plant. Only the flowers of the latter are succeeded by the fruit, which consists of seeds inclosed in the green flower cup or calyx. When ripe, the seeds are shaken out, dried, and sold as food for birds, as they like it much, and it is very nutritious; or the seeds are crushed to express their oil, which is used to make varnish, and some kinds of soap.

But hemp is grown chiefly for its fibre, which is strong, tough, long, and flexible. When the fibre is the chief object of its cultivation, it is sown thickly and broadcast. This increases its length, and also its fineness. When full grown, the barren flowered plants are plucked up by the roots first, and then the fertile ones a few weeks later, when the seeds are ripe. Hand rubbing separates the seeds. Then the roots and tops are cut off, which serve as manure to the fields, the stems are tied in bundles, put into water to steep, to loosen or dissolve the soluble from the fibrous part. This process is called **Retting**. The water in a short time emits a very offensive odour, and it is said to become even poisonous. When sufficiently rotted the hemp is removed, and the woody matter is treated as flax. The hemp is then heckled, which renders it fit for being spun into yarn.

Hemp is used largely for all kinds of cordage, for which it is well fitted. The spinner fastens a bundle of hemp round his waist, draws out a few fibres, twists them, attaches them to a hook, which is turned rapidly round and round by a boy at a large wheel, or by machinery. The spinner walks slowly backwards, feeding out the hemp as fast as it is twisted, and keeping it in a uniform thickness, and he goes on thus till he arrives at the other end of the rope-walk. This yarn is twisted a second time into *strands*, and three of these strands are a third time twisted into a *rope;* and, finally, three ropes are twisted again into a *cable*. About eighty tons of cordage are required for a large first-rate war ship, at a cost of about £3000. The water in which flax and hemp have been steeped becomes poisonous; care should be taken that no animals are allowed to drink of it.

SILK.

Prop'agated, produced.
Depos'ited, laid down.
Attain', reach.
Protec'tion, means of safety.
Select', choose.
Tor'pid, dull and dead-like.
Secrete', send out.
Convey'ed, carried.
Tena'cious, tough, not easily broken.
Effec'ted, done.
Trip'le, three times.

Silk is the product of caterpillars or silk-moths, reared originally in China, but now largely propagated in the warmer countries of Europe and America. These moths are hatched from dark-coloured eggs, of the size of mustard seeds, a year after they have been deposited. They feed on mulberry leaves, which they eat largely, and soon increase in size, and they are then changed to a cream colour. They attain their full size in about eight weeks, during which time their skin has cast or changed four or five times. Then they begin to form their cocoons of silk as a protection for themselves during their chrysalis state. They generally select a corner, attach their threads, and soon enclose themselves in their cocoons, which take about five days to spin, and are shorter than their own bodies. In these they lie, become torpid, change their skin, and so complete their chrysalis state. A fortnight or three weeks is sufficient to effect the further change from the chrysalis state to that of a moth or perfect insect. The last act they require to perform to effect this change is to secrete a fluid which softens a part of the cocoon, and thereby they are enabled to escape from their cocoon, which otherwise would become a prison-house. This they secrete from two glands, one on each side of the interior part of their bodies, and from which it is conveyed by vessels like ducts or tubes to the apertures, called *spinnarets*, placed at the front of their heads. The threads are glued together as soon as they issue forth, and they become one fibre so small or fine that 1000 of them laid side by side measure only one inch in breadth.

These fibres are spun into raw silk by twisting several of them into thread, which is very tenacious, being double the strength of hemp, and triple the strength of flax.

But before the silk can be obtained the animal must be heated to death in an oven or steam bath. This being effected, the outer, rough floss is taken off, and the cocoons put into vessels of hot water, and set over a fire to loosen the threads. By stirring the cocoons in the water with twigs, the ends of the threads are caught, several of them are wound on a reel, the reeled silk is tied up in hanks, and in this state it is called *raw silk*. The quantity of silk got from a single cocoon is from 200 to 300 yards in length, and it takes about 2000 cocoons to make a pound weight of raw silk. The raw silk is washed in warm water, and wound on bobbins or reels by a winding machine. It is afterwards twisted or *thrown*, by uniting several threads together into yarn. If very strong thread is wanted,

several yarns are again twisted together, or *doubled*, and exposed to steam-heat to *set*, that is, to prevent them untwisting, which they would do if not so treated.

If cloth is woven of silk having two colours, the warp being of one colour, and the weft of a different colour, the fabric is called **Shot Silk.** This makes the cloth appear to change colours when looked at from different points of view. *Satin* has the warp all thrown upon one side of the cloth, which makes it very soft and glossy. This is effected by carrying the weft *over* five or six threads and *under* one, and so on, instead of under and above every alternate thread. *Velvet* is made by short looped threads left above the surface of the cloth. These loops are cut by a sharp instrument, leaving the cut ends of the thread projecting above the surface of the cloth, and this spreading out and over the crossed threads, gives the cloth a very soft, rich, and glossy appearance. The chief silk mills are at Derby, in England. The manufacture of silk is carried on at Spitalfields, Coventry, Macclesfield, and other places in this country. But its chief seat is Lyons, in France, where the Jacquard loom was invented.

WOOL.

Distinc'tion, difference.
Sor'ted, arranged in different kinds.
Adher'ing, sticking to.
Revol'ving, turning round
Increas'es, makes greater.
Dimin'ishes, makes less.

Wool is the fibrous covering of the sheep. It is cut from the sheep in the hot season of the year. It is washed and sorted, and is afterwards carded and spun. The woollen manufactures of this country are carried on chiefly in Lancashire and in Yorkshire; but they are also successfully carried on in Wales and Scotland. Germany is the chief seat of foreign manufactures; but they are also carried on in France. There is a distinction between *woollen* goods and *worsted* goods. Woollen goods are made of short-fibred, fine wool, which is brought from Saxony and Australia, and consists of broad cloths and kerseymeres. Worsted goods, on the other hand, are made of the coarse, long-fibred wool of England, and consist of flannels, blankets, moreens, merinos, hosiery, and worsted goods, &c. A fleece of wool is not all of one quality. The wool of a fleece is separated and sorted into several qualities. These differ in length of fibre, in colour, and in the fineness of the fibres. These several kinds are all washed separately in hot ley, to remove any dirt or greasiness adhering to the wool. The wool is afterwards dyed, and subjected to the action of revolving spikes, to tease the fibres loose, and form them into a sort of woollen down. Then the wool is carded to straighten the fibres, after which it is spun into yarn, and then woven into cloth.

Woollen cloths are put under a process of *felting*, by being beaten with large, heavy hammers. This lasts some hours, and, in some cases, even days. This beating causes the fibres to lock or adhere together, by means of their natural scales, with which they are covered, upwards of 2000 of

them covering an inch, and which surround the fibres in a series of rings. The coarse wools of England have fewer scales on the fibres, and they are therefore less fit for felting, and are chiefly used in making *worsted* goods. Felting increases the thickness of the cloth; but it also diminishes the length and the width. Kilmarnock bonnets are made thick and smooth, and very unlike woven and knitted cloth, by a like process of felting. The nap of the cloth is afterwards raised by a process of teasing. This consists of fixing the flowers of a plant, which are thickly covered with elastic hooks, on a frame, or on the rim of a broad wheel, and causing the one or the other to move rapidly over the surface of the cloth. By this means the fibres are all drawn in one direction, and are afterwards cut or shorn quite close to the cloth. The cloth is now damped, then brushed, and afterwards pressed to bring its surface to the soft, smooth, uniform, and finished-like state in which it is found in our markets.

TURPENTINE.

Vol'atile, goes off easily in vapour.
Crude, raw.
Adhe'sive, sticky.
Inflam'mable, easily set on fire.

Turpentine is a volatile spirit, distilled from the juice of the bark and wood of the *pinus silvestris;* but Venice turpentine is distilled from the larch, and Canadian turpentine from the *pinus balsamea.* When the bark is cut, the crude juice flows from it, and is of an oily nature, nearly as thick as honey, of the same colour, and adhesive. This crude secretion is collected and subjected to distillation, when the spirit, called turpentine, is separated from the resin, which is what remains after the distillation has been effected. This spirit, thus obtained, is without colour, volatile, and of the nature of an essential oil, with a very strong odour.

Turpentine is largely used by painters to mix in their oil-paints to dry them quickly, and to prevent the paint having a glossy or shining surface. It is used also in making varnishes. Turpentine is very inflammable, and burns with much flame and smoke. It is used to remove paint stains from cloth, &c.

The resin obtained at the same time, by the same process, and from the same juice as the turpentine, is used in colouring soap, in caulking the seams of wooden ships, and in making sealing-wax for bottle-corks. It is also used in plasters, and by musicians to rub the strings of violins.

CASTOR OIL.

The Castor Oil plant grows naturally in the East and West Indies, but it is now cultivated in America, Africa, and the south of Europe. It is sometimes grown in this country in gardens as an annual; but it does not rise higher than four feet. Its leaves and whole form are beautiful.

The oil is often obtained from the seeds by pressure, and when so prepared is said to be *Cold*

Drawn. But in the West Indies the seeds are first stripped of their husks or pods and then bruised in a mortar. They are afterwards tied in linen bags and boiled. The oil comes to the surface, and is skimmed off and bottled for use. This kind is milder than the other, but does not keep so well. The uses of castor oil in medicine are well known, and the purest kinds have little more taste or smell than good olive-oil.

TAR.

Procur'ed, obtained, got. | **Exu'des**, sweats out.

Tar is procured from the roots and part of the trunk of a species of pine tree. It is got chiefly from Norway, Sweden, and Russia. It is obtained in the following manner: a circular hole is dug in a sloping bank near the forests where the trees grow. The hole is made narrower towards the bottom, and quite smooth on the sides by beating. An iron pan is placed at the bottom of the pit, and a pipe is set to lead from the pan through the sloping bank, to drain off the tar. The roots of the trees and the lower portions of the trunks, are cut up into small pieces, and then placed very carefully in the pits, which are filled with them, and the pile in the pit kindled. After the wood has kindled, and is burning freely, the pit is covered with turf and earth. It is then allowed to burn slowly, and, as the heat increases, the tar exudes from the wood, and runs down into the pan, flows through the pipe, and into barrels placed beneath the pipe to receive it. The tar is then made, and the barrels are closed up, and made ready for being shipped.

Tar is also used medicinally, and chiefly as *tar-water*.

PITCH.

Distil', fall in drops.
Fran'gible, easily broken.
Dense, thick.
Inflam'mable, easily set on fire.
Resist', withstand.
Preser've, keep from waste.

Pitch.—When tar has been distilled, and a volatile spirit drawn off from it, the substance remaining is called *pitch*. It is solid, bright, and very frangible. It is also very inflammable; both it and tar burn with a bright flame, but dense smoke. Both pitch and tar resist the action of water. They are very useful on that account. They are used to preserve ropes, and to make tarpaulin, which is waterproof. They are also used to coat the bottoms and sides of ships and boats, to coat stobs and fences to preserve them from rotting, and other purposes.

Pitch was much employed by the ancients to flavour their wines. Pitch is imported chiefly from Sweden and Norway. Considerable quantities of tar and pitch are, however, prepared in this country, but not enough to meet the demand.

LINSEED.

Hydraul'ic press, a press worked by water power.
Expres'sed, squeezed out.
Infu'sing, steeping in water.
Extracts', draws out.
Muc'ilage, thickish fluid.
Sup'purations, wounds containing matter.

The **Linseed**, or common flax plant, is grown both for its seed and its fibre. It is an annual, having green, slender stems, generally about two feet high. The leaves have no footstalks, and are small, narrow, and pointed at the top. Blue flowers grow at the top of each stem, followed by a seed-vessel that contains ten flat seeds of a dark-brown colour, and an oblong shape.

The seeds are cleaned from dirt or dust, by being sifted, and are then crushed between rollers to break the cells of the seeds which contain the oil. After being crushed, the seed is ground to a fine powder, between stones. The powder is afterwards heated to about 140° in kettles warmed by steam. When removed from the kettles, it is put into woollen bags, which are covered with slips of horse-hair cloth, closely woven. These bags, filled with the ground seed, are then put into an hydraulic press, and pressed with great force, which causes the oil to flow out into small grooves, that conduct it into a large cistern. What remains in the bags as the refuse of the seed-powder, is called oil-cake, and is used to feed cattle. Oil-cake brings a good price, generally about £12 a ton; and the oil expressed is sold for about £35 a ton.

Linseed-oil is much used in paint, as it dries quickly. Mixed with whiting it forms *putty*. Linseed-oil is wholesome, but unpleasant, and is not used as food. The seed husks make linseed tea, by infusing them in boiling water, which extracts the mucilage which they contain; and the powder of the seeds, called **linseed meal**, is made into poultices for dressing sores and suppurations.

OLIVE OIL.

Od'our, any kind of smell.
Fra'grance, pleasant smell.
Ran'cid, having a strong smell.
Suffic'es, is necessary.

Olive Oil.—The olive has been found growing naturally, that is, without cultivation, in Syria, Persia, and Arabia. It is a small tree or evergreen shrub. It has irregular branches, with lance-shaped leaves, which are green, but have a grey tinge. The flowers are small, white, and possess a sweet fragrance. The fruit is like the damson in shape, size, and colour. The tree grows as high as ten feet, and is very thick in the stem. The pulp of the fruit is bitter, rough, and oily. The stone of the fruit is pointed. The olive is now cultivated in Barbary and the warmer countries of Europe. The trees continue to grow for many years,—some say nearly two thousand, as those in the garden of Gethsemane.

The oil is pressed from the fruit in bags by a press. That which requires little pressure is the

finest or virgin oil, but that which requires the fruit to be heated or great pressure to squeeze it out, is what is commonly sold as olive oil. There is a quantity of oil got from the pressed fruit by boiling, but that is used in making soap.

Olive oil is tasteless, without odour, of a pale yellow colour, and keeps without turning rancid. It is inflammable, but a less degree of cold than suffices to freeze water, makes it solid. It is used in Spain and Italy just as cream and butter are used in this country. Some people in this country use it as food. The worst and cheapest kind is largely used in wool and soap factories. It is too dear to be much used for lighting lamps.

CAMPHOR.

Conden'se, become thick or heavy.
Gran'ular, in the form of grains.
Translu'cent, shining.
Evap'orate, go off in vapour.
Debil'ity, weakness.
Lin'iment, ointment.

Camphor is obtained from a shrubby tree of the laurel species. The tree grows without cultivation, and abundantly, in the forests of China and Japan, but it is now grown in all warm countries. Large quantities are grown in the island of Formosa. The branches of the camphor laurel are smooth, and the leaves are of a bright, green colour, thick and glossy on the upper side, but pale on the under side of the leaf.

The whole tree, which grows to a considerable size, (root, trunk, branches, and leaves), contains camphor. To obtain it from any or all of these parts, it is necessary to chop them into small bits, and put them into iron vessels or stills, having suitable covers. The covers must contain some light material to attach the camphor when it rises in the still, such as straw, rice, small twigs of trees, or such like. The vessels are then heated, and the camphor rises in vapour, and is soon condensed on the straw, or whatever is placed inside the covers, and attaches itself in crystals to it. The camphor is afterwards separated from the straw, &c., and is then called Crude Camphor. At this stage it is in a granular form, and is somewhat coloured; but the colour is not well marked or brought out. It is imported in this state, and is afterwards redistilled, when all appearance of colour leaves it, and it is obtained quite pure and white. It is now solid, very tough, and translucent. It is also very light, and it has an aromatic odour. It is soluble in spirits and oil, but not in water, which will even separate a solution of camphor and spirits, and reduce the camphor again to a solid state. Heat melts it, but it also changes it to vapour. Camphor burns with much flame and smoke. It is very volatile. If left exposed in the air, it will soon all evaporate.

Camphor either keeps away or destroys moths and some other insects. It is, therefore, a protector of blankets, carpets, and all woollen clothes, which moths destroy so much, and also of preserved objects of natural history. Camphor is stimulant at first, if taken into the human system; but it soon becomes sedative. It

is popularly used as a charm against infection; but this use of it is not only not effective for that purpose, but it induces debility of the nerves and muscles of the body. A solution in spirit is a cure for chilblains, burns, and scalds, if the skin is unbroken. A solution in oil makes a good stimulating liniment.

INDIA-RUBBER.

Exu'des, sweats or runs out.
Incis'ions, cuttings.
O'val, egg-shaped.
Fet'id, bad-smelling.
Elas'tic, springing back when bent.
Insol'uble, not able to be melted.
Fus'ible, able to be melted.
Sur'gical, belonging to wounds.

India-rubber, or caoutchouc, is formed of a gum which exudes from cuts or incisions made chiefly in two trees that grow in Brazil, Guiana, and Cayenne. It is also obtained from another plant, the *urceola*, which grows in the East Indies, and is a species of *Euphorbia;* but the two former belong to the fig tribe of plants. The American trees grow to a height of sixty feet; but the trees in the east do not grow so high. The urceola has large, thick leaves, pointed, of an oval shape, and a glossy appearance. It bears small figs; but they are not eaten. When the bark is cut, large quantities of a thick, milky, white juice flow out from the wounded bark. To obtain the juice, the bark has to be cut into the wood of the tree, and these cuts are made within twelve inches of each other. More juice flows from the upper than the lower cuts. The juice, when collected and exposed to the action of the air, separates into two substances—the one firm and elastic, is India-rubber, and the other is a fetid, watery liquid, of a yellow colour. If the juice, as it flows from the tree, is kept in a close vessel from contact with the air, no separation occurs. If it is poured out into shallow vessels and exposed to the air, the watery portion of the juice is evaporated, no fetid liquid is formed, and nothing is left but the pure India-rubber.

In the east, the juice is allowed to flow from the cut trees into small trenches, cut in the earth at the roots. This is the cause of its being brought to this country in balls or pieces of a thick, irregular shape. But in America, the natives spread it in layers, one above another, on clay bottles or on clay slippers, and as one layer dries, they apply another till they become thick enough, when the clay moulds are broken, and the rubber retains the shape of the mould on which the juice was dried. The process of drying is quickened by placing the moulds with their layers of juice over a wood fire. The juice is dried much sooner in this way than by the sun and air; but the juice is blackened by the smoke of the burning fire wood.

India-rubber is tough, very elastic, not easily cut, but soft and pliable. The elasticity is increased by heat, and diminished by cold. India-rubber is insoluble in water; but it may be softened and made slightly adhesive by being boiled in water.

Spirits or weak acids do not dissolve it; but it is easily dissolved in heated ether, turpentine, and naphtha; but the India-

rubber remains unchanged when these solvents are evaporated. Oil acts on it as a solvent; but not a perfect one, for the solution resembles glue in consistency. A solution in naphtha will cause pieces of India-rubber to adhere, as glue joins wood. India-rubber is fusible in a high degree of heat; but the act of fusing destroys its property of again becoming solid. It is inflammable, burning with a white flame, dense smoke, and a strong odour. In Guiana, torches are made of it. It is often torn up by spiked machinery, and reduced to a soft mass, when it is pressed into solid blocks, which are afterwards cut by wet knives in a machine into *thin sheets* or *threads*. The threads are stretched eight fold, wound on to rollers in their extended state, kept in that state about three weeks, when by the cold they lose their elasticity. They are then woven into bands for various purposes, as elastic for boots, bands for gloves, braces, brace ends, surgical bands, and other things. Elasticity is restored to all these articles by heat, after they are woven. In America and India, the natives spread the juice as it flows from the tree on cloth, and various things, to make them waterproof. In this country, a solution in naphtha or turpentine is spread on one side of cloth, and sometimes on one side of two pieces, which are then pressed together to make waterproof cloth, and garments, such as Mackintoshes, and ladies' waterproof cloaks.

Marine glue, largely used in shipbuilding, is made by dissolving India-rubber and shell-lac together. India-rubber is used to *rub out* or remove black lead pencil marks from paper, and, from this use of it, the name India-rubber has been given to it. India-rubber is made more elastic by being vulcanized—that is, by being heated with sulphur, but the sulphur deprives it of its adhesiveness. It is this vulcanized caoutchouc that is made into gas, and other tubes, water pipes, springs, elastic bands, fishing boots, drinking cups, sponge bags, knapsacks, balls, and many other things. Elastic bands are reddened by adding *antimony* to the sulphur in vulcanizing the *India*-rubber. India-rubber is compounded with mineral pitch to form an imitation of horn, and this is made into various articles, such as combs, chains, pen-holders, brooches, bracelets, crosses, and other things.

GUTTA PERCHA.

Adjoin'ing, neighbouring.
Knead'ed, worked and pressed.
Plas'tic, soft.
Resists', withstands.

Gutta Percha is the juice of a tree, growing naturally, or without cultivation, in Sumatra, Malay, and the adjoining islands; and these are the only places in which it grows. The juice is obtained by cutting the trees. It is then found thick and white like milk, in a fluid state, between the bark and the wood, but it soon hardens in the air. As it hardens, it is kneaded into large pieces, in irregular shapes, and, without further preparation, is shipped to this country. Here it is cut into shreds, washed, and the pieces are united again into a mass, by means of heat and

pressure. From twenty to thirty pounds is generally got from one tree. Gutta percha is tough, strong, light, of a brown colour, tasteless, odorous, and somewhat harder than leather. Weak acids and spirits do not dissolve it; but it is dissolvable in ether, turpentine, and naphtha. Warm water easily softens it, and makes it plastic. It is inflammable, burning with a good deal of smoke, and a white flame. It is a non-conductor of heat and electricity, and it resists the action of cold water.

Gutta percha is made into bottles, cups, inkstands, trays, picture frames, machinery belts, soles for boots and shoes, sheeting, water pipes, tissue, speaking tubes, and other things. It is used also as an insulator for marine telegraph wires.

GUM ARABIC.

Procu'red, got.
Pin'nated, feather-like.
Glob'ular, round.
Compres'sed, squeezed.
Adhe'sive, of a sticky nature.
Translu'cent, shining.
Insip'id, tasteless.
O'dour, smell.

Gum Arabic.—The tree from which gum arabic is procured grows naturally in Arabia, Abyssinia, the East Indies, and New Zealand. In Van Diemen's Land there are one hundred species, some of which grow 150 feet high, and 40 feet round. The eucolyptus or gum tree grows 180 feet high, and 36 feet round. The gum tree belongs to the Acacia tribe of plants, of which there are a hundred leafless species. One of these grows in Central America. It produces as good gum as the species growing in the east. The *black wattle*, which grows in Australia, is another species which produces gum in great quantity. The gum tree grows about 14 feet high. It has pinnated leaves. The flowers are small and of a globular shape. They spring out from the joints of the branches in clusters of three each, on separate foot stalks. The flowers are followed by pods of a curved form. The pod is closely compressed between the seeds. This gives the pod a rounded appearance. A thorn or spike is produced from each side of each jointed branch.

The gum is secreted by the tree, and it oozes out from natural cracks in the bark, or from cuts made in it. It flows out in the form of a thick mucilage, but it soon hardens by the action of the air.

In a pure state gum is translucent, and without colour. But the more common kinds are of a yellow hue. Gum is insipid, of a glossy lustre, and it has no odour. It is soluble in water; but if allowed to stand, the solution, which is thick and adhesive, is changed by a process of fermentation.

Gum is largely used in the process of printing and dyeing cloth, as a cement for labels, for glass, and other small articles, for stiffening various cloths, as crapes, muslins, and some other articles; for keeping small tufts of hair in a curled state, and for making ink. It is also used to cement paper and other articles, by besmearing one side of them,

letting them dry, and then moistening the gum which makes it adhesive.

The gum used for postage-stamps is not the Arabian, but British gum, called *dextrine*, made from starch by baking it in an oven till it becomes pale brown, and also soluble in water. A little sugar added to it renders it more easily or quickly moistened.

CLOVES.

Clus'ters, bunches.
Elong'ated, lengthened.
Aromat'ic, sweet-smelling.
Ac'rid, biting.
Vol'atile, escaping in vapour.
Fla'vour, give a nice taste to.

Cloves. — The clove-tree is a small evergreen tree, somewhat like the myrtle. It grows naturally in the Spice Islands and the Moluccas; but it is now cultivated in both the East and the West Indies. It grows as high as thirty or even forty feet; but its average height is from twenty to twenty-five feet. It has larger leaves than the myrtle. The flowers are small. They grow in clusters at the ends of the branches, and are beautiful and very fragrant. The cloves are gathered just before the buds open, are dried in the sun, over a smoky fire, or in a kiln, and are then packed for shipment.

Each clove has a rounded end, formed of the petals and filaments, and an elongated part, formed of the flower-cup and the seed-vessel; and each of these parts may be seen or examined by steeping one or more in boiling water till the parts become softened. An ordinary-sized tree produces about three pounds of cloves; but a much larger quantity has been got from some of the larger trees. The odour of cloves is strong, but agreeable, being very aromatic, and the taste is very *pungent*, and both are caused by an abundance of acrid, volatile oil. All the parts of the clove-tree are aromatic, especially the root, bark, leaves, and fruit. Clove means *nail*. The clove-buds are so called because they are like small nails in shape. The French word *clou*, and the Spanish word *clavo*, are used to signify a nail, and our word *clove* is derived from them. Cloves are now sold at the rate of from eightpence to a shilling a pound; but the Dutch used to charge more than two shillings a pound, when they had the trade entirely in their own hands.

Cloves are used as spice to flavour food, and in some cases as medicine.

SUGAR-CANE.

Peren'nial, lasting several years.
Express', squeeze out.
Impu'rities, foreign matters.
Gran'ulated, grain-shaped.
Clar'ify, make clear.
Per an'num, every year.

Sugar-Cane, it is said, grows naturally, *in India*, China, and *America; but it is not* the same species in each case. The sugar-cane is a kind of grass. The root is jointed, but not hollow, like many

canes. It is a perennial plant, and several stems rise up from the root to a height of six, and in some cases twelve feet. The stems are smooth, but jointed; have no branches, and are filled with a sweet juice, from which the sugar is made. The leaves are about four feet long, and three inches broad. They grow from the joints in single leaves, which wrap the cane round circularly at first, and then open out. A small cluster of flowers of a pale lilac hue, and having a downy appearance, grows at the top of the stems. The sugar-cane is not grown from seed, but from cuttings, which send forth new stems for several years. In the West Indies, the trees are usually cut down before the flowers appear at the top of the stems, and they are often destroyed by insects, rats, and monkeys. When the sugar-canes ripen in March, they are cut down, and again cut into proper lengths, then carried to the sugar-mill, are there crushed and pressed between rollers to express the juice, which is boiled with lime to separate all impurities. These impurities rise to the top of the boilings and are skimmed off. The liquor is then boiled quickly, and until it thickens, when it is allowed to cool, and drain, and become what is called moist or raw sugar. This boiled juice is afterwards put into pierced casks, which let the molasses drain off, and leave the granulated sugar in the casks. One hundred canes, it is said, produce about five gallons of juice, and that is equal to about five lbs. of sugar. The crushed canes serve for fuel to boil the juice; but they must be sun-dried first.

Sugar is obtained also from sweet maple in North America, and from beet-root in France. But sugar can be extracted from many other vegetable substances. Equal quantities in weight of sugar and water ferment in a warm place, and produce carbonic-acid gas and alcohol.

Raw sugar is purified by dissolving it in hot water, and adding a little lime; this is then filtered through cloth thickly folded; but this process, though removing some of the impurities, does not clarify it, for the colouring remains an unchanged brown. To remove the colouring matter from raw sugar it is again filtered through *bone black*, or animal charcoal (*see* Charcoal), which absorbs the colouring matter in the sugar. The filtered syrup is then pumped into covered boilers, called *vacuum pans*, and heated by steam in pipes, and the vapours which rise from the boiling syrup are pumped off by means of an air-pump. This process prevents the sugar being burned in the boiler, as it would be, if fire were used to boil it under the pressure of the atmosphere. After being boiled, the syrup is run into moulds, where it cools and becomes solid. To purify it still more, a small quantity of clear syrup is poured on the top of each mould, and this flows down through the mass in the moulds, and carries away along with it any of the sugar that has not been formed into crystals. The solid mass in each mould is called a loaf of sugar. All the liquid that remains after these processes have been gone through, is called treacle. It takes about thirty-four lbs. of raw to make twenty lbs. of refined sugar.

Five years ago the quantity of sugar used in this country was equal to *forty-three* lbs. per annum

to each person. Sugar is *candied* by allowing the hot syrup to cool very slowly. Threads are put into the liquor, and the sugar forms crystals around the threads. In making *barley-sugar* the water is all boiled off, and some acid is added to prevent the syrup crystallizing. The syrup is then poured out on slabs, and when cool enough, is cut into lengths or narrow stripes, like sticks, and rolled and twisted into the shapes required.

Most of the sugar used in France is got from the beet-root.

GINGER.

Nat'urally, without cultivation.
Trop'ical, warm, near the Equator.
Bleached, made white.
Spe'cies, kind or quality.
Preser'ved state, state for keeping.
Confec'tion, mixture of fruit and sugar, or other like substances.

Ginger.—The ginger-plant grows naturally in the tropical countries of Asia, but it is now cultivated in the East and West Indies, and in Africa. It seldom grows above three feet in height, and it has a very beautiful reed-like form. After the ground has been cleared of weeds it is cut up into trenches like those which gardeners make for raising celery. Into these trenches the plants are set about the month of April, and they begin to flower about the month of September. The creeping-stems, or races, as they are called, which are like fibrous roots, but fleshy, bear narrow lance-shaped leaves, and from these stems the stalks grow. These stems have rooty fibres growing on the under side, which are the real roots of the plant. The flowers are white and purple, and grow on stems by themselves, forming a kind of ear or spike which is remarkable for its beautiful colours and fragrant smell. When the leaves are withered, these creeping stems are dug up, put into boiling water, and are cleaned and dried. In this state it is called black ginger; but it is not black, for the skin of the stem is merely of a dirty, greyish-brown, or stone-colour. Black ginger is cheaper than white because its preparation takes less time and labour. When the skin is scraped off the stems, the ginger is then called white; and white ginger is made whiter still by being bleached in this country by means of chloride of lime. The ginger grown in the East Indies has a skin much lighter coloured than the species grown in Africa, and is at the same time much stronger than any we get from Jamaica.

Ginger is often sold in a preserved state. The stems or races are dug up in the spring, when they are young and tender, and are well cleaned, have boiling syrup poured upon them, and are then packed in jars. These form a very nice confection. Powdered ginger is much used in medicine. It is one of the three powders forming Dr. Gregory's famous mixture: magnesia and rhubarb being the other two. Ginger is often used as a *flavour* in other substances, as cakes, snaps, ginger or gingerbread, biscuits, and jams or jellies. It is also used to make the beer called ginger-beer, and the wine called ginger-wine.

CINNAMON.

Incis'ions, cuttings.
Pli'able, easily bent.
Tub'ular, like a tube or pipe.
Req'uisite, necessary.
Pal'atable, nice to the taste.
Nau'seous, not pleasant.

The Cinnamon tree grows naturally in Ceylon and the East, but it is now cultivated chiefly in Ceylon. It is also grown in Java, Sumatra, Malabar, Jamaica, and some of the West India Islands. The cinnamon tree is a species of laurel. It grows best in a sandy soil, enriched with decayed vegetable matter, and under the shade of larger trees. It grows to a height of thirty feet, if not cut. The trees are grown from seed, and take six or seven years to grow six feet, but they are not barked till they are nine years old. Then, at the end of the wet season in May, the trees are cut and stripped of their bark. The cutting and stripping continue up till November. The branches are cut off, and incisions are made round the branches at certain distances, then the bark is slit up on each side from cut to cut and peeled off. The bark is thin, smooth, shining, pliable, and of a yellow colour. The bark is brought from the woods where the trees grow, and dried in the sun, when the outer separates from the inner bark, and is taken away from the latter, which is thin, and curls up into tubular pieces of about three feet in length. The smaller pieces are placed inside the larger, tied up in bundles, and packed for shipment. The bark of the older branches, and that of the younger, are equally inferior as a spice, not possessing the requisite quantity of essential oil. Indeed, the bark of the thickest branches is of little or no value, if not really useless. The best cinnamon is very thin, nearly as thin as paper, of a yellowish-brown colour, and breaks in splinters. The others are coarser and thicker, and not so pungent or sweet.

Cinnamon is used to flavour many articles of food, particularly puddings, and other sweet dishes. It is used in other countries to flavour chocolate. It is used in this country to make other medicines more palatable. The oil of cinnamon is a powerful stimulant, and is sometimes used as a cordial in cramps of the stomach, and in fainting. There is a distilled water obtained from cinnamon very useful as a vehicle for nauseous drugs.

NUTMEGS.

Indig'enous, native to.
Fer'tile, fruitful.
Preser've, keep.
Prevent', hinder.

Nutmegs. — The nutmeg tree grows indigenous in the Moluccas and Spice Islands; but it has been extended to Java, Sumatra, Penang, Bencoolen, and other islands, and also to the West Indies. The height of the nutmeg tree is from twenty-five to thirty-five feet. It has forked branches, having large shining leaves, of an oblong shape, and resembling those of the laurel. The trees begin to bear fruit at the end of seven years. The flowers are

small, white, two or three on a pendicle, and are either barren or fertile. The barren flowers all grow on trees quite distinct from the fertile ones. The full-grown fruit is like a roundish pear, and of the size of an apricot. It is greenish, smooth, and fleshy, but becomes yellow when ripe, and is divided into two nearly equal parts. The nutmeg proceeds from a reddish nob in the centre of the flower. The fruit opens, and the nutmeg is seen in a dark, shining shell, enclosed in a network of *red mace*. The shell is like a filbert, and is thin, hard, and dark brown. It encloses the kernel. The kernels are collected and carefully dried in the sun, or by the moderate heat of a fire, till the kernels are heard to rattle in the shells. The shells are then broken, and the kernels are dipped into lime-water to preserve them from insects. The kernels are oval-shaped, about an inch long, and have a rough or furrowed surface. The substance of the kernel is grey, with streaks of reddish brown, veining it all through, like marble. It has a warm, aromatic taste, and a pleasant odour, and is thoroughly impregnated with oil. The heaviest nutmegs are the best, as they have not been deprived of their oil in spirits, or been destroyed by insects. There are three sorts, the *wall*-nutmeg, the *royal*, and the *green*. The trees are male and female. The one produces barren and the other fertile flowers. The trees are ten years old before they are in full bearing, and they continue to bear after that for about ninety years. The fruit does not all grow ripe at once, only a third of it ripens at one time; and it is gathered first in July, then in December, and lastly in April. The best nutmegs are obtained at the last gathering. A tree is said to produce about three lbs. of nutmegs, and one lb. of *mace*.

Nutmegs are much used to flavour food, on account of the strong stimulating oil they contain. They are also used to prevent or remove spasms, to which many people are subject.

PEPPER.

Ovate', egg-shaped.
Glob'ular, round.
Benefi'cial, of use.
Stim'ulant, something to increase action.
Inju'rious, hurtful.

Pepper is a climbing plant, and it is generally trained against trees. It takes four years to bear fruit. It sends forth a stem having jointed branches, about twelve feet long. The leaves are dark green, pointed, smooth, shining, and ovate. The flowers are small, without petals, and in the form of long spikes. The flowers give place to the berries, which are of a globular shape, and contain only one seed; but as many as forty or fifty grow on one spike. They are green when newly formed, but change to a bright red when ripe, and afterwards, when dried, turn black.

Both black and white pepper are got from the same plant, the difference in colour arising from different modes of preparing the pepper. To make *black* pepper the berries are gathered in a green state, just before they ripen, and are dried in the sun, when they

become black. To make *white* pepper the berries are not gathered till quite ripe. When gathered, they are steeped in water, which bursts the skins of the berries, and by drying them in the sun, and by rubbing them, the skins are separated and removed, leaving the berries, which are of a whitish or pale brown colour. They are larger in size than the black, and are much less acrid, and also much less pungent.

Pepper is used to flavour food, and as a stimulant to aid the process of digestion. It is thought to be beneficial when taken along with fat meat, cucumbers, and other indigestible food; but too much of it is injurious to health.

ALLSPICE.

Fol'iage, leaves.
Succeeds', grows after.
Matu're, ripe.

Fre'quently, often.
Brit'tle, easily broken.
Attach'ed, joined.

Allspice, pimento, or Jamaica pepper, which is a West Indian kind of myrtle, grows naturally in Jamaica. The tree rises to a height of thirty feet. It has a smooth stem, spreading out in branches near the top. The twigs and flower stalks are covered with soft down. The leaves are evergreen, dark, glossy on the upper side, and are somewhat like the bay-tree leaf. The flowers appear in July and August, are small and white, and beautifully set off, surrounded by the rich, deep green foliage of the tree, which fills the air around with its delightful fragrance. A round berry succeeds the flower. The berry, when ripe, is smooth, glossy, and of a dark, purple colour. Each berry contains two seeds, which are ready for being gathered in the month of September, or shortly after the blossoms have fallen. The tree begins to bear at three, but the fruit is not mature till the tree is seven years old. It grows best in a rich soil, on rocky land. The average produce of berries from a tree is said to be from eighty to a hundred lbs.; but the trees do not bear equally every year; only once in five years do they yield an abundant crop.

The berries require to be picked at full growth, just before they are ripe, and carefully dried, to retain the full flavour of their aroma. They are dried in the sun on boards by being frequently turned during the first two or three days. They are afterwards put into sheets to be winnowed, and are again exposed to the sun, which changes their colour from green to dark brown. When the seeds are heard to rattle in the berries they are known to be dry enough. The berries are then rough, light, brittle, and show a scar where they were attached to the flowers.

Allspice is cheaper than other kinds of spice, and is used to flavour food, and as a gentle stimulant. Its flavour is like that of a mixture of cloves, nutmegs, and cinnamon, and it was on that account that the name, allspice, was given to it.

The leaves of the pimento yield an oil which is often used instead of oil of cloves.

STARCH.

Immers'ed, plunged into.
Bril'liant, shining.
Gran'ular, grain-shaped.
Tex'tile fabrics, stuffs made by weaving.
Domes'tic use, home use.

Starch forms a part of many vegetable substances, and is found in many parts of the structure of plants. Starch is necessary to their growth, and is stored up in them for future use. Before being used, and as it is insoluble, it is changed into sugar, which is very soluble, and then it is fit for the nourishment of the plant during its growth. The growth of potatoes, and the malting of barley are examples of this change, which may be seen and examined by most people.

Starch is prepared from wheat, rice, potatoes, Indian corn, sago, tapioca, &c. It is insoluble in cold, but soluble in hot water. If a potato be grated down in a dish holding cold water, the pure white starch will fall to the bottom, and may be seen when the fibre of the potato and the coloured liquid are poured off. If a little flour is put into a muslin bag, immersed in water in a dish, and well squeezed, the starch will ooze out through between the threads of the muslin, and the gluten of the wheat will remain in the bag. On settling in the dish the starch falls to the bottom, and the water may be poured off. The starch is then found to be a granular powder of a brilliant, white colour. When dissolved in boiling water it forms a thick paste, like mucilage of gum.

Starch is used to stiffen linen and muslin clothes in domestic use, and also textile fabrics during the processes of manufacturing them, or as a dressing to give them a finished appearance when completed.

Dry heat renders starch soluble. **Dextrine** is made by drying starch in an oven till it becomes brown, at a degree of heat slightly beyond that of boiling water. This is used for gumming postage stamps and envelopes, and also in glazed print-works. Starch forms a part of all the vegetable food we eat, and it is eaten in a pure state in the form of arrowroot, sago, tapioca, and corn-flour. Starch is also used medicinally for various purposes.

SAGO.

Pin'nated, feather-like.
Flores'cence, coming into flower.
Sub'sequent, coming after.
Cylin'drical, roller-shaped.
Nutri'tious, nourishing.
In'valids, sick persons.

Sago is the pith of several species of palm-trees, growing in Malay and the islands near it. The height of the tree is about twenty-five feet, and its diameter about eighteen inches. The stem has no branches, but it is covered at top with large, spiny leaves, and of a pinnated form. At the end of a few years—from ten to fifteen—it shoots forth a long spice of flowers through the tuft of leaves at the top, as the last act of its vegetable existence, and then begins to decay. The mid ribs of the leaves are twelve or

fifteen feet long, very light, and very strong. The natives build houses with them, besides using them for many other purposes. The stem is a hard, hollow case, half an inch thick, and filled with pith, which is wholly absorbed in the act of florescence described above, and in the nourishing of the subsequent fruit.

To obtain the sago the tree is cut down close to the ground when full grown, the leaves and the leaf stalks are cut off, and a good broad stripe of the bark is taken from the upper side of the stem or trunk. The pith is thus exposed throughout the whole length of the stem, and it is seen to be white towards the top, but darker or dingy near the lower end. The pith is then like the pulp of a dried apple, but having woody fibres running through its whole length, at a distance from each other of a quarter of an inch. The pith is cut or bruised out from the stem in the form of a coarse powder, by a hard wooden club, and is carried away in baskets to be washed at the nearest water. This is done by a wooden machine, made chiefly from the sago tree. Troughs are made of the large leaves, and a strainer of the leaf-stalk fibres. The pith is then kneaded in water, and pressed against the strainer till all the starch has been separated from the fibre, and has passed through the strainer. The fibrous refuse is then cleaned out and thrown away, and another basketful put in and treated in the same way. The water and pith are run on to another trough, which is deeper in the centre of the bottom than in the sides, where the pith starch is deposited as a sediment, and the water is run off by small outlets. When this second trough is full, or nearly so, the starch is made up into cylindrical pieces, and covered with sago leaves. Each piece weighs about thirty pounds, and in this state it is ready for sale. But the sago sold in this country is rubbed through a sieve into a pot made of metal, and put over a fire to dry. Hence its granular form, and the grains are large or small according as the sieve is coarse or fine. Nine hundred lbs. are said to be obtained from a tree of good size. The natives use it as food. It is nutritious, wholesome, and easy of digestion. It is used in this country to make puddings, and as food for children, and also for invalids. Being nearly pure starch, sago does not yield all the elements of the human frame, so that other kinds of food containing what it wants, are required to support the body in health and strength,—a fact not always duly attended to.

ARROWROOT.

Ul'timately, at last.
Grate'ful, pleasant.

Incre'ases, makes greater.
Suppli'ed, furnished.

Arrowroot.—The stem-roots of trees which yield arrowroot grow without being cultivated in both the East and West Indies, and *in Central America.* The botanical name is *Maranta Arundinacea;* but it was called arrowroot because it was thought to extract the *virus* from wounds made with poisoned arrows. Arrowroot is obtained from two species of plants growing in the

West Indies. They are small trees, not more than three feet high in the stem, which shoots forth branches. The tree has long leaves, of an oval shape, and pointed. The flowers are small and white. The starch is obtained, not from the real roots, which are small, but from the root-stem, which grows under ground, but ultimately shoots forth above ground as a new plant, and for the nourishment of which the starch is there. The root-stems are dug up when about a year old, the earth is washed from them, and then they are beaten into pulp in a wooden mortar. The pulp is well stirred in a large tub of clean water, and the fibrous part of the roots are wrung out and thrown away. The milky liquor is then passed through a hair-sieve or coarse cloth, after which it is allowed to settle, when the clear water is drained off. The starch is then dried on sheets in the sun, and this completes the process of preparing arrowroot for sale in the shops. It is very white, contained in small bulk, and nutritious. When boiled, it forms a grateful, light, and nourishing jelly. A hundred lbs. weight of the root-stem is said to yield from fifteen to twenty lbs. of pure arrowroot. The best kind comes from Bermuda.

The East Indian plant is quite different. It belongs to the family of plants of which the ginger-plant is one. The root-stem of this plant is pungent, orange coloured, yields the substance called turmeric, which is used in making curry-powder. A number of small, round tubers spring from the central stem; but these are different from it, both in respect to taste and colour. They are white and full of starch, which is got by the same process as the West Indian kind, described above. This kind is reckoned unequal to that which comes from the West Indies. Arrowroot is used as a light food for children and invalids. It is easily digested, sits lightly on the stomach, and should be boiled with milk, as that increases the nourishment supplied by its use.

TAPIOCA.

Essen'tial, chief or principal.
Fi'nally, at last.
Evap'orates, goes off in vapour.
Inju'rious, hurtful.

Tapioca.—A starch produced by the *Jatropha manihot*, a plant grown in warm countries. The plant is a poisonous one; but the poison is contained in its essential oil, which is volatile, and easily separated from it by heat. It grows about twenty feet high, and has a large root, which contains poisonous sap. When in a fresh state, these large roots are grated down to pulp, the juice is drained off, and then washed in water. When the starch settles at the bottom the water is poured off, and the starch dried in the sun. This starch in this state gets the name of Brazilian arrow-root. If, instead of being dried in the sun, it is dried on hot plates, the starch is formed into a mass of paste, which requires to be stirred with an iron rod, by which it is finally broken up into irregular pieces. The heat of the plates evaporates all the essential oil which may have been contained in the starch, and deprives it of all its poison-

ous or injurious properties. This dried paste is called tapioca. It is used boiled in milk as a light food for children and invalids. It is also made into puddings, which contain besides it, milk and eggs. This is a very nourishing diet for weak stomachs or sick people.

The juice which drains from the grated roots is sometimes boiled. It is thus made into cassaripe, which is a very pleasant sauce.

Cassada bread is made by washing and scraping the roots clean, grating them in a tub, and squeezing out the juice through a hair-cloth bag, by great pressure. The thinner portion of this pressed juice is evaporated, and the remainder dried in a stone basin over a fire, and made into cakes.

BUTTER.

Unc'tuous, oily or greasy.
Extracts', draws out.
Expe'rience, practice.
Di'et, food.
Spar'ingly, in small quantities.
Ran'cid, strong-smelling.

Butter.—An unctuous substance obtained from the milk of animals—chiefly of the cow. Long and continued agitation, called churning, of the milk or cream produces butter, which comes to the top in little pieces like small peas, and is made into a solid mass, and cleansed by a process of kneading and cutting, which extracts the cow-hairs that may be mixed with it. The process of making good butter requires much skill and experience. The milk must be pressed entirely out of the butter or it will be milk tasted, and soon turn rancid.

It is used as an article of diet in this country, and when spread thinly upon bread is wholesome, and few stomachs reject it. It is also used as sauce, and, mixed with flour, it is made into *paste*. In this form it has become an important article in the stock of the pastry-cook; but pastry is very indigestible, and should be used sparingly. If butter is used too freely it produces skin diseases, very difficult to remove. Too much butter given to children is a frequent cause of boils, of discharges from behind the ear, of eruptions on the head, and other parts of the skin. Rancid butter is very unwholesome, and should be rejected by every one who is anxious to enjoy good health.

BREAD.

Mucilag'inous, soft and slimy.
Sac'charine, sugary.
Prop'erties, qualities.
Knead'ed, baked.
Innum'erable, very many.
Cav'ities, hollows.

Bread is an article of diet, made from the *farina* of various plants. The farina consists of mucilaginous, saccharine matter, starch, and gluten. Gluten has many of *the properties of animal* matter. *It is most abundant* in wheat-flour. In making bread the flour is made into a paste, called *dough*, by being mixed with water and kneaded; the proportion being generally two parts water, and three parts flour. Old flour requires a little more

water than new flour. When allowed to stand some time this paste ferments, a chemical action changes the ingredients and forms *alcohol*, *carbonic acid*, and *acetic acid* or *vinegar*. If the paste, which is now called *leaven*, is then baked in an oven, the bread will be sour and unpleasant. But if some of the unbaked paste or leaven be added to new made paste, the fermentation begins sooner, carbonic acid is given off, but its escape is prevented by the gluten, which expands like a membrane or small web of tissue, into innumerable little cavities or air-cells, and the bread is thus made light or spongy. Too much leaven makes the bread sad, heavy, or doughy, a condition not very suitable for use.

BARM.

Collec'ts, gathers. | Prefer'red, chosen before.

Barm, or the *ferment* that collects on the surface of fermenting beer, if added to dough, makes better bread than leaven does. In this country *barm* is preferred to leaven in making bread. After the dough has been fermented and properly raised, it is baked in an oven, the heat of which is raised to about 448°. Bread is quite different from the flour it is made of. The ingredients of the flour cannot be chemically found in the bread. Bread mixes more easily in water than flour does, and it is more easily digested.

The sorts of bread are the *fine*, the *wheaten*, and the *household*. The first is made of flour only; the second, of flour and fine bran; and the household, of the whole grain, which includes both the fine flour and the coarse bran. New bread is very unwholesome and indigestible, and should not be eaten. It should stand at least twenty-four hours after baking before it is used. New rolls are not so bad as new bread, if they are well baked, and have a good large crust in proportion to the soft part inside. Toasted bread is good for invalids having tender stomachs. When bread sours on the stomach, toasted bread or biscuits without butter should be taken instead. Bread eaten with rich soups makes them, it is very generally believed, more easy of digestion.

PAPER.

Revol've, turn round.
Quire, 24 sheets.
Ream, 20 quires.
Absorb'ent, sucking in.
Impres'sed, stamped.
Translu'cent, clear and shining.
Con'sequently, therefore.
Comple'te, finish.

Paper is made from rags, both cotton and linen, from straw, Esparto grass, hempen materials, &c. Paper was first made from the papyrus shrub, and it continued to be made from it till *700 A.C., when* cotton and silk paper came into use. Linen rags were not used till 1200 A.C. Books and manuscripts (MSS.), were made in rolls or volumes of parchment, &c., or stitched books, which are called codices.

In making paper the rags are

picked and sorted according to quality, cut into small pieces, shaken by machinery to separate dirt and dust, and boiled in a solution of soda to cleanse them more fully from dirt and colour. They are then put into a large cistern having water in it, in which a cylinder is made to revolve, having steel bar-knives attached, which cut the rags as the cylinder revolves against other bars fixed in the bottom of the cistern, and soon reduce the whole to a pulpy mass. The cylinder is brought closer to the bottom as the pulp becomes finer, to secure its thorough reduction. *Chloride of lime* is then applied to bleach the pulp, and sometimes the pulp is afterwards coloured by some smalt blue.

Some paper is hand-made, and some machine-made. The hand-made paper is formed by dipping a square mould into the pulp vat, filling it, and lifting it out. The mould, having stretched across it a fine wire sieve, is shaken to drain off the water, and bring the pulp in it to an even surface. The contents of the mould are poured out on felt cloth, and another piece of felt cloth placed above it. The mould is dipped again into the pulp, and the same process is repeated till about eight quires of paper have been placed between the felt cloths. The whole pile is then pressed by machinery to free the pulp between the cloths from all the water it may still contain, and to reduce it to solid, but thin sheets. Having been pressed, the pile is removed, and a boy separates the paper from the felt cloths. The felts are then ready to be used again in the same manner. Two men and the boy can make eight reams a day in this way. The paper is pressed again, and dried to make it smooth. It is then just like blotting-paper, soft and absorbent, and unfit to be written on; but these qualities are removed by dipping the paper into a thin solution of glue or size. This done, it is pressed, dried, and pressed again, and this completes the process of paper-making. It is then finished paper. The next thing is to count it, and arrange it into quires and reams.

Wove paper takes its name from the wires of the sieve being finely interwoven; and foolscap has the wires of the sieve arranged in parallel rows. The name of the maker is impressed on the paper by the letters being wrought into the wires of the sieve. These letter wires press the paper thinner than the rest of the paper, and leave a translucent mark on the paper. *Satin* paper is made by pressing the best kinds of pulp between sheets of very smooth pasteboard, heated by sheets of hot iron. This process is called hot-pressing. *Blotting* paper is unsized and porous, consequently it rapidly absorbs the ink when the one touches the other. *Brown* paper is made of canvas, sacking, or other hempen substances. *Pasteboard* is made up of many sheets of paper pasted and pressed closely together in a press.

Machine-made paper is made on an endless band of wire-gauze, and the pulp is drained, pressed, and dried on a piece of endless felt, and then wound on to a cylinder. Not more than two minutes are taken to complete these processes.

In 1873 the quantity of writing and printing paper imported into the United Kingdom was valued at about £594,000. The chief supplies come from Germany, France, and the Netherlands.

INK.

Astrin'gent, binding.
Decoc'tion, something made by boiling.
Corro'des, eats away.
Limp'id, thin.

Ink is made of nut-galls, sulphate of iron, sugar, gum, and water. The nut-galls are powdered and boiled in water to dissolve their astringent substances. The gum and the sulphate of iron are dissolved in water, and added to the decoction of the galls. The astringent principles of the galls unite chemically with the sulphate of iron, and the compound is a black liquid, which is thickened with sugar and the gum. Logwood and blue vitriol added improve the colour, but the vitriol corrodes steel pens. Newmade ink is pale; but it absorbs oxygen from the air which darkens the ink. Ink should be so limpid that it will flow easily from the pen, and run into the pores of the paper; but not so thin as to flow out too rapidly and blot the paper. Dampness and age will cause the decay of the vegetable substances in the ink and so reduce or efface the colour; but a strong solution of galls will revive the faded lines. Brazil wood boiled in vinegar, and thickened with a solution of gum Arabic, makes *red* ink. Prussian blue and a solution of oxalic-acid, mixed together, make *blue* ink. Lamp-black and linseed-oil make printer's ink. Fancy-coloured inks have not come into general use.

VINEGAR.

Ref'use, remains.
Permit'ted, allowed.
Prevents', keeps away.
Putrefact'ion, rottenness.
Assis'ts, aids or helps.
Alla'ys, quenches.

Vinegar is a sour liquor, resulting from the fermentation of a liquid containing a small quantity of spirit, kept some time in a warm place. Vinegar means sour wine, because it used to be made from weak wine. Wine exposed to the air becomes sour, and this sour wine was called vinegar. Vinegar is made in this country from weak beer, without hops, put into open barrels, but covered with a coarse cloth, and placed in a warm room. This process requires a few weeks to complete it. Sometimes this fermented liquor is mixed with the refuse of the fruit that has been made into British wines, and fermented a second time. The process of fermentation may be quickened by allowing the liquor to drain slowly through the twigs of birch-trees, or the shavings of beechwood.

Malt-vinegar is of a yellowish red colour, has a sharp acid taste, and a cooling, refreshing odour. A little oil of vitriol increases the sourness of the liquid. One gallon to a thousand is permitted to be added by the Excise-office. Vinegar prevents putrefaction. It is used on that account to pickle or preserve fruits and vegetables. A small quantity of it taken with meals assists digestion, and also allays thirst; but in large quantities it weakens the stomach, destroys the action of gastric-juice, and is generally injurious to the whole system. Hence care should be exercised in its use.

LIMESTONE.

Cement'ed, joined firmly.
Du'rable, lasting long.
Facil'ity, ease.
Mal'let, wooden hammer.

Limestone, a carbonate of lime, is found lying in large beds in Yorkshire, Dorsetshire, Somersetshire, and in the Isle of Portland. It is dug from pits or quarried.

Portland-stone is like the roe of fish—consisting of small grains closely cemented together. Other kinds consist chiefly of shells, and are called shelly limestone. Some kinds of limestone are soft, as Bath-stone, but harden by the action of the air. The harder kinds of limestone are also heavier. Limestones are durable, but they differ in the length of their duration under the action of the air. Some decay in about two hundred years, others last a thousand. Some are white, some of a greyish brown, some of a cream, and others of a drab colour.

Limestones are much used in building. Lincoln Cathedral; Roche Abbey, Yorkshire; the Houses of Parliament, Westminster; the interior of St. Paul's London; and many mansions and houses in London, and throughout the country, have been built with limestones. The stones are cut into the various sizes required with saws fixed in heavy frames, with water and sharp sand. Bath-stones are easily cut, being soft; but all kinds of limestones are cut, with various degrees of facility, by the mallet and chisel of the hewer.

Great quantities of limestone are burned in kilns to expel the carbonic acid they always contain, and to change them into quicklime, for mortar in building, or for manure in the cultivation of the soil.

CHALK.

Mari'ne or'igin, sea formation.
Infu'sible, cannot be melted.
Fri'able, easily rubbed into dust.
An'tidote, something to destroy the effect of poison.
Defic'ient, in small quantities.

Chalk, a carbonate of lime, is abundant in England. It forms the Downs in the south-east of England, and the ranges of low hills which, near the sea, form the white cliffs that gave the name "Albion" to the country; but around London, the chalk lies deep below the surface of the land. Great quantities of flint are found embedded in the higher strata of chalk; but in the lower strata almost none is found.

Chalk is not found in every country. There is none, for instance, in North America.

Chalk is of marine origin. It contains sea-shells, corals, the teeth of sharks, and the remains of crabs, lobsters, and other sea-animals, thought to have been embedded in the chalk when it was in a fluid state. When chalk lies near the surface of the land, it is dug out or quarried for use. Chalk is white, infusible, soft, friable, of an earthy fracture when broken, and is changed into quick-lime by being burned in kilns, to free it from its carbonic acid.

Chalk is much used for several

purposes. The coarser kinds are used for mortar, and the harder for building houses in Hampshire. It is used for writing and drawing on slates and black-boards. Chalk is also made into whiting; and the whiting is used for cleaning windows and metals, and in making white-wash for walls by being mixed with water and size or glue.

Chalk unites readily with acids; and is therefore used as a medicine for the stomach to absorb acrid juices. It is on that account also a most valuable *antidote* in any case of *acid poisoning*. If *oxalic-acid*, *sulphuric-acid* or *oil of vitriol*, *nitric-acid* or *aqua-fortis*, or *hydrochloride* or *spirit of salt*, has been swallowed, chalk, whiting, or white-wash scraped from the walls, should be given *immediately*.

Chalk is found in all soils, but chiefly in those best fitted for agricultural purposes. Where it is deficient, it is supplied as a manure—forty tons to an acre. It is better than lime for this purpose. It lasts longer, and the soil becomes lighter. Soil containing from five to twenty parts of chalk is called *marl*; when more than twenty parts of chalk are found in the soil, it is generally known by the name of *calcareous earth*.

MARBLE.

Restrict'ed, confined, used only.
Transpa'rency, clearness.
Dec'oration, ornament.
Architec'tural, belonging to buildings.
Import'ed, brought into Britain.

Marble is a variety of carbonate of lime. There are different kinds of it; but the name is generally restricted to what is crystalline, or granular in structure. When the particles are closely or compactly set, the marble is capable of receiving a very fine polish when rubbed with sand, emery, and a substance called putty-powder. Marble is not a porous stone like sand-stone, but it possesses a very small degree of transparency when cut into thin pieces. Some marble is black, some white, and some is *variegated*, *streaked*, or *spotted* beautifully; and some kinds have a red, grey, green, blue, or yellow hue. A mixture of other minerals is the cause of the variety in the colours of marble.

Busts and statuary are cut of fine white marble, imported chiefly from Monte Altissimo, in Italy. The marbles of Carrara, which are of a blue or yellowish colour, are also much used and prized. The block of marble for the statue of George III., in London, was stated to have cost 1,200 guineas. Large quantities of other *veined* and coloured marbles, and also the snow-white variety, are used in making ornaments, and for architectural decoration. Derbyshire, Devonshire, Inverness, Banffshire, the Western Isles, Kilkenny, and Anglesea supply many varieties of beautiful marble. The United Kingdom imports great quantities of marble from Italy — about one-sixth of the whole quantity produced in that country. The British Islands are rich in all kinds of marble containing shells, corals, and other similar substances. Marble has been known from very early times. The palace of Ahasuerus had pillars and a pavement of marble,

MORTAR.

Sla'ked, mixed with.
Fre'quently, often.
Effec'ted, done.
Resis'ts, is not changed by.
Procu'red, got.
Pen'etrating, coming through.

Mortar consists of quicklime slaked with water, and sand with a sufficient quantity of water to make it into a soft, thick, paste, when well worked or mixed together. Good mortar or lime, for such it is frequently called, is made with three parts sand, and one part of quicklime. The mortar used in buildings is spread between the bricks and the stones placed in the walls. By exposure to the air, and by contact with the building materials, the lime absorbs carbonic acid, and parts with its water, and thereby becomes limestone again, and so hardens and binds into a solid mass, the bricks or stones, between which it has been placed. After this change has been effected, the lime or mortar is no longer *soluble;* but resists the action of rain or water, just as well as the original limestone did, from which one of the ingredients was procured. When lime or mortar contains a small portion of silica finally divided, and clay, it will set or harden even in water. This kind of lime is used in building piers, and embankments, and in pointing walls to prevent dampness from penetrating through their seams. It is called cement-stone, and is found in beds of clay. London, Somersetshire, Yorkshire, Kent, and the Isle of Wight, supply it in large quantities, and it is found under the name of *Arden lime*, in the parish of Eastwood, near Glasgow. *Blue lias* is another kind of this *hydraulic cement*, found in North Wales and in the counties of Dorset and Leicester. *Roman* and *Portland* cement are most used, but particularly the latter.

GYPSUM.

Abun'dantly, plentifully.
Dec'orating, making pretty.

Gypsum is found abundantly in Yorkshire, Somersetshire, Derbyshire, and Nottinghamshire, and also near Paris. It is soft, white, pearly in lustre, and partially transparent or translucent. The transparent crystallized variety of gypsum is called *selenite*. Another kind is known by the name "alabaster." This is used in large quantities in making vases, and other ornamental objects of vertu.

Gypsum is lime united to sul*phuric acid, and is* called sulphate *of lime; it contains* also in its *composition a quantity* of water, which, on being heated, evaporates, and reduces the sulphate of lime to what is called "plaster of Paris," because it was first made there. If water be mixed with plaster of Paris, reduced to a powdered state, so as to form a paste as thick as cream, the plaster of Paris and the water combine, and re-form gypsum, or sulphate of lime, which in a very short time becomes solid. This property of hardening or setting quickly renders it very valuable, and causes it to be much used as a cement for ceilings, &c.

Plasterers use it largely in decorating the ceilings of houses; artists, in making casts and statuary; and printers in making casts of their type in stereotyping. It is used for these purposes without admixture, but in building it is sometimes mixed with sand. Some kinds of gypsum are made into necklaces.

SILICA.

Brit'tle, easily broken.
Fu'sible, able to be melted.
Combi'ne, join or unite.
Com'pound, something made up of more than one part.
Admix'ture, union.

Silica forms a large, if not the **largest**, portion of the earth's **crust**. When pure, it is rock **crystal**. Slightly coloured by admixture with other substances, it forms quartz, flint, sand, gravel, and **sandstone**; and in combination with other minerals, as for instance, felspar and mica, it forms granite; with alumina, it forms clay; and with mica, slate. Silica is hard, brittle, insoluble in water and acids, and is also infusible; but when it has been brought to a white heat, and united to an earthy or alkaline substance, it forms a fusible compound, which is called **glass**. The alkalies potash and soda, or the earth, lime, &c., combine thus with silica to form this most useful compound.

FLINT.

Stra'ta, beds.
Plas'tic, yielding.
Fran'gible, easily broken.
Superse'ded, come in place of.

Flint is a form of silica. It is found in the upper chalk strata in England, and in some of the surrounding countries of Europe.

Flint is sometimes found in nodules, or irregular globular masses, with shells, corals, fish scales, sponge, and other impressions stamped upon them; and sometimes in layers or veins, which fill up the fissures of the chalk rocks. The impression of a shell or a fish is sometimes impressed partly on a piece of flint and partly on the surrounding chalk — thus showing that both the flint and the chalk as elements were at one and the same time in a soft and plastic state. Flint has a faint *lustre, it is hard,* and is very *slightly translucent.* It is frangible, and it has a shelly fracture when broken. Rubbed in the dark, two pieces produce a faint light, and a peculiar odour. Struck on steel, it produces sparks. It is infusible; but when heated it loses its translucent quality, becomes white, and much more brittle. Some portions of flint are grey, some of a yellow tinge, and others of a reddish black colour.

Flint was long used with steel to light tinder, but lucifer matches have superseded it; to fire guns, but percussion caps have caused it to be laid aside; to make glass, which was called *flint glass*, but sand is now employed instead. Flints, when large, are used in building and road-making; but their brittleness, hardness, and jagged edges very soon wear the

shoes of the horses and the tires of the wheels, whilst they are themselves ground to dust. The dust of flint, however, is not mere waste. After being washed, the stonecutter makes use of it in sawing stones. Flint, when mixed with clay, forms earthenware, the uses of which are important and well-known.

SAND.

Insol'uble, not able to be melted *by water.*
Infu'sible, not able to be melted *by fire.*
Fer'tile, fruitful.
Per'vious to, letting in or through.
Exam'ples, instances or cases.

Sand consists of small rough grains of silica, white when pure, but often tinted or coloured by other substances. It is insoluble in water, and infusible by fire. Sand is largely distributed over the various countries of the world. It often forms the beds of rivers, seas, and oceans, and it is found forming large tracts of land, called *deserts*, particularly in Africa, and some parts of Asia. Sand is an important element in all fertile soils, — making them porous, and therefore pervious to water and air. Sand is often added to clayey soils to improve them by making them lighter and more porous. Plants do not grow well in sand alone; it does not yield them the food they require. Tracts of fine sand are often thrown up on parts of the sea-beach in this country, and driven more inland by strong winds. The *dunes* of Holland and Denmark, and the *landes* in the south-west of France, are examples in Europe of sand having been so driven by the wind. Sand tracts may be known by the abundance of heath, furze, and ferns growing on them. Sand is much used for many purposes, the whiter kinds in making glass, the coarser in making mortar and bricks. It forms the inside lining for the ladles of iron moulders, in casting, and also a coarse scouring material for metals.

SANDSTONE.

Cemen'ted, bound in a mass.
Per'colation, passing through small openings.
Va'ry in hue, are of different colours.
Tinge, slight colour.

Sandstone.—Sand closely cemented together, forms sandstone, which is found in large, rocky masses, and is quarried for building purposes. Some kinds of hard, gritty stone are used as grinding stones, millstones, sharping stones for scythes, and other *cutting instruments;* and some, *being very porous,* are used as *filtering stones* for water, and, when broken into small pieces, stones are placed in drains to aid the percolation of the rain from the fields, and from the walls of houses to keep them from dampness.

The most noted quarries for sandstone are Bolton, Duffield, Matlock, Mansfield, Stanley, Dean Forest, Hollington, Whitby, Leeds, Huddersfield, Knares

borough, Stainton, Pensher, Heddon, Kenton, and Brunton in England: and Dumbarton, Edinburgh, Forfar, Lanark, Renfrew, Linlithgow, Perth, Stirling, and Ross in Scotland.

Some portions of sandstone are of a whitish brown colour, some are grey, some red, and others vary in hue, being in some cases of a blue, of a yellow, and of a purple tinge.

The finest grinding and millstones are got from Yorkshire, France, and America. They differ in no great degree from the building-stones or flag-stones of which they form a part. The best hard sandstones which are not used as grindstones, are much used for pavement, and especially in the neighbourhood of London.

Scythe-stones are made in considerable numbers in many different parts of the country. In making these considerable skill is shown by the men, women, and children employed for the purpose.

ARTIFICIAL STONE.

Erec'tion, building or making.
Dissolv'ing, melting.
Subject'ed, made to undergo.
Architec'tural, relating to building.
Agita'tion, motion.
Ul'timately, in the end.

Artificial Stone has been made for various purposes. That known as "Ransom's patent" is made with sand and a glassy cement. It looks just like natural stone, and is much used in moulding ornaments for buildings, in the erection of fountains, and other things. The glassy cement is made by dissolving flint in a boiler of caustic alkali, heated to 300 degrees, under great pressure. The solution obtained is silicate of soda, or potash. Then pipe-clay and powdered flint are well mixed in a mill with sand or road drift, and a portion of the cement. The mixture is afterwards pressed into moulds, and then laid on flat surfaces to dry. It is further subjected to a drying process by being baked in a potter's kiln, slowly at first for 24 hours, but brought up to, and kept at a red heat for 24 hours longer,—and then it requires nearly a week to cool. "Concrete" is another patent stone, made without burning, and coming largely into use for architectural decoration, and for building piers, water-spouting, theatres, factories, and houses. The schoolhouses at Garmouth, near Elgin, are being wholly built of concrete. It is called "Drake's patent," and is made up of shingle from the beach at the mouth of the Spey. A boxful of shingle is mixed with a bagful of cement, on a wooden platform, in a dry state; then water is added, and it is kept in a state of agitation till used. It is carried in pails or buckets to the walls, and poured in between iron plates, fixed according to the thickness required for the walls. These plates permit about two feet of the walls to be raised, and when set, which it does rapidly, the plates are removed next day, raised higher, and again fixed, and other two feet are added to the walls; and so on till the building is completed. The mass of concrete becomes ultimately as hard as iron. "Val de Travers" is also used in paving footpaths and even streets, but not as yet to any very great extent.

CLAY.

Opa'que, not able to be seen through.
Absorb'ent, sucks or dries up moisture.
Imper'vious to, not letting in.
Fertiliz'ing, fruit or crop producing.

Clay is an earthy mineral, quite opaque, and of a dull appearance. It is white when pure, but mixed or compounded with iron or other substances it is found of a brown, reddish, yellow, black, grey, blue, or even greenish colour. When moist or wet, clay is soft, plastic, and easily polished; but when dry, it is hard, porous, and absorbent. Moist clay has a greasy feel; it is inelastic; it has a slight, peculiar odour, and is also impervious to water. When moulded, drying does not alter its form or shape, and burning, even to a red heat, not only makes it hard, brittle, and porous, but destroys its property of again becoming plastic in water.

Clay is found in large masses called *beds*, which are often very thick, lie near the surface of the ground, and above gravel or sand. It is also found largely diffused in the various fertile soils which produce large crops; and the best lands contain about half their weight of clay when the soil is weighed in a dry state. A "sandy soil" has very little clay in it, and a "clayey soil" has very little or no sand in it, whilst a "loamy soil" has more clay than sand. Clay absorbs and retains the various salts or fertilizing elements contained in the manures added to the soil, and prevents the rain washing them away through the drainage of the land, but it does not retain them in such manner as to prevent the roots of plants growing in the soil, absorbing them for the nourishment of the plants. It is thus that a heavy clay soil produces the largest and the heaviest crops of wheat, beans, and other plants.

The finer and purer kinds of clay are used to make earthenware and china, and the coarser or coloured kinds, to make bricks, tiles, flower-pots, chimney cans, and many other things. Clay is largely used in moulding figures, lining canals, ponds, and embankments, for retaining water. Another kind of clay, different from that noticed above, is called fire-clay. It is very infusible, and is used to make glass pots, crucibles for melting metals, fire-bricks, drainage pipes, chimney pots; and also to line smelting furnaces, and in many other ways.

FULLER'S EARTH.

Con'tact, touch.
Preven'ting, keeping away.
Re'cently, lately.
Superse'ded, come in place of.

Fuller's Earth is a kind of clay having a greasy feel, falling asunder *on being wet*, and is quite *different from* common clay in *not being plastic*. It absorbs oil and grease whenever it comes in contact with them, and it is to this quality that it owes its cleansing properties and value. This is why it got the name "Fuller's

earth," and this is why it has been so much employed in the processes of the woollen manufactures to cleanse the fibres of the wool. Fuller's earth is obtained in large quantities in Surrey, Bedfordshire, Hampshire, and Berkshire. It has been much employed in cleaning the floors of houses from greasy spots, and it has been used in preventing chafing in the hands of children. Until recently it was of great value in the country, and its exportation to other countries was even forbidden by law; but now the manufacture of *soap* and *soda*, and other chemical substances, has almost superseded its use as an article of commerce for cleansing purposes, but for other purposes it continues to be much used.

BITUMEN.

Vis'cid, sticking like gum.
Exu'ding, sweating out from.
Immen'se, large.
Vari'eties, kinds.
Ingre'dients, the substances of which anything is made.

Bitumen is an inflammable mineral, sometimes solid, as **asphaltum** or **asphalt**, sometimes liquid, as **petroleum**, and sometimes in a purer or distilled state, called **naphtha**. Asphaltum is a black fusible solid. Petroleum is a viscid oil or fluid, and naphtha is a colourless liquid. Pure asphalt is found in large quantities on the shores of the Dead Sea, but it is found in an impure state or mixed with earth, &c., in Barbadoes, where it is dug up and burned as coal; and near Auvergne and Neufchatel in France. Petroleum is found in Italy exuding from the seams of the rocks in the lower Morone, near Tesco, and flowing into the little rivulets, which run into the river Arollo. It is also found in Trinidad, where there is the pitch-lake, three miles in circumference, and of unknown depth. It exists in great abundance in Burmah, at the Irrawaddy, where the soil is thoroughly saturated with it, and where upwards of 600 pits or wells are dug to let it drain into them. Large quantities are *brought from that country to this. But the naphthas*, or the thinner fluids of this mineral, are obtained chiefly from America. Immense quantities are got in Pennsylvania, at the coal-fields of the Alleghany mountains, and from the oil-wells of Ohio and the Western districts of Virginia.

The fluid varieties of bitumen are distilled and yield petroleum, or oil for burning in lamps. It is largely used for this purpose. The greatest quantity of petroleum comes to this country from the United States. Bitumen, or asphalt, burns with a dense flame and much smoke. It is used along with gravel as a *paving cement*. Bitumen is contained in coal as one of its ingredients—the other being wood in the state of charcoal.

The mortar with which the walls of Babylon, and of the Temple of Solomon, were cemented were, in all likelihood, a preparation of asphalt.

Bituminous shales, or beds of clay, are now very much worked. These shales are found among the coal measures. Till lately they were considered of little or no importance; but their cheapness has led to a great change in this respect.

COAL.

Britt'le, easily broken.
Lus'tre, clearness or brightness.
Soils, dirties or makes black.
Disclo'ses, shows.
Lubrica'ting, making greasy or slippery.
Ascertain'ed, found out.

Coal is an opaque, black mineral, occurring in masses. It is brittle, and breaks with a slaty fracture. It has the lustre of the resins. It is not uniformly hard, but varies much in this respect, some kinds being soft and others pretty hard, and capable of being cleft. It is combustible, and burns with a bright flame and much smoke. The results are very different when burned in the open air, and in a close vessel. In the latter it is much changed. All the inflammable part goes off in gas, and what remains is *coke*, or charred coal.

The kinds of coal are;—the *common*, or bituminous coal. This soils the fingers, and leaves a cinder when half consumed. The *Cannel*, or candle coal, burns with a bright flame, does not soil the fingers, and takes a fine polish, just like black marble. The *anthracite*, or blind coal, or culm. This yields no gas, burns with difficulty, has no flame, leaves no cinder when half consumed; but it burns well in furnaces, with a strong draught of air, gives great heat, little smoke, and it is found in the Welsh coal-fields. The best coals are freest from earthy substances, and they leave no ashes when burned.

Coal is of *vegetable* origin, but it is regarded as a *mineral*. Many of the varieties of coal are fibrous, *and show the grain* of the wood *from which they* have been *formed. The microscope* discloses vegetable remains, and these prove that coal has been formed chiefly from ferns and fir trees, and other vegetable productions; but the ferns and the trees are not exactly of the same kind as the ferns and the trees now growing.

The use of coal is to burn in houses and factories to give heat and flame. It is applied in smelting the metals, in making glass and pottery ware, bricks and tiles, gas, coke, tar, pitch, &c. It is used in working the steam-engine, in producing the various chemical substances of commerce, in compounding and extracting the various substances used in medicine, and in the processes of distillation and brewing, and dyeing.

From coal tar, naphtha is distilled, and from naphtha is obtained benzole. A solution of benzole in nitric acid produces oil of almonds, or nitro-benzole. And nitro-benzole, subjected to the action of acetate of lime, produces aniline. This, in turn, subjected to the action of an oxide of the several metals, produces the beautiful colours called mauve, magenta, rosaline, opaque blue, and others.

If coal be distilled at a low temperature, the more volatile substances contained in it are obtained in a liquid state; and if these are purified, paraffin oil is obtained, an oil or grease for lubricating machinery, and also paraffin in a solid form, which is so much employed now in making

candles. The best coal for producing paraffin products is the *cannel* coal.

The coal-fields of Great Britain extend to 6,000 square miles—4,000 in England, and 2,000 in Scotland. There is rather more coal in Ireland than in Scotland. The beds or seams of coal vary in thickness from a few inches to 80 feet. The existence of coal is generally ascertained by boring, and it is obtained by sinking one or more shafts, 12 or 15 feet in diameter. These are lined with wood, cast-iron, or bricks, to keep out water, and prevent the sides from falling in. Some coal is found at the surface, but generally it is from 100 to 1,800 feet deep. The seams of coal are worked in rooms or passages varying from 10 to 15 feet broad, and varying in height according to the thickness of the seam. These rooms and passages are extended and crossed to such an extent that they resemble the streets and lanes of a large town. In some cases pillars of coal are left to support the roof, and in others artificial pillars of wood are set up for that purpose. In some coal fields there are only a few seams of coal, but in others there are as many as 37; and these are separated from each other, generally by shale, a kind of slaty clay, and by grit, a kind of hard sandstone.

SULPHUR.

Emits', sends out.
Dischar'ged, sent out.
Cra'ters, mouths of volcanoes.
Conden'sed, made thick.
Inha'led, breathed into.
Combi'nes, unites or joins.

Sulphur is an inflammable mineral, of a yellow colour, and insoluble in water. It has neither taste nor smell when cold, but emits odour when warmed. United to any of the metals it forms a sulphuret. Thus we have the sulphur*ets* of copper, of lead, and of zinc; these are called *ores* of these several metals, and they are found in most of the countries in the world. The sulphuret of iron is useless as an *ore*, but is very valuable as a source of sulphur. This ore contains more than half of its weight of sulphur. Sulphur is discharged in the form of a vapour from all the active volcanoes in the world, and it becomes solid, or gets condensed, among the gravel and ashes which are also discharged from the *craters of the volcanoes.* Sulphur *is also found in solid* beds in Sicily, and this country is the chief source of our supply. The sulphur beds of Sicily consist of gypsum, limestone, and clay. It is found in globular masses in the clay, but often in a uniformly or irregularly mixed state, in parallel seams, or in crystals in the gypsum and the limestone. Sulphur is separated from limestone by heat, being burned, as wood or coal is, to form charcoal. Sulphuret of iron, heated in a close vessel, sends off half its weight of sulphur in a state of vapour, which is collected again in another and more distant portion of the apparatus, where it is subjected to a cooling process, either in a solid or a liquid state; and what remains in the vessel where the sulphuret was heated becomes, when exposed to the air, what is called "green vitriol," a

chemical combination or preparation of iron, much used in dyeing black colours, and in making ink.

Prepared sulphur is cast in moulds into rolls, or small cylinders. Sulphur melts when heated into an orange coloured fluid; heated to a higher degree it becomes deep red, and much thicker in consistence; and heated still higher, it then becomes thinner. And if this last degree of heat be applied to it in a close vessel, the sulphur will boil away into vapour, as water does into steam; and this vapour may be condensed by cold into a solid, or, with less cold, into a fluid state. But heated in the air, it burns with a blue flame, and emits a poisonous gas, which is most disagreeable and irritating when inhaled into the lungs. Sulphur unites easily with the metals. This can be seen by any one, by putting silver coins and some sulphur into his pocket, when the silver will become black like a bad or leaden shilling. It can also be felt by eating an egg with a silver spoon, when the yolk of the egg, which contains sulphur, will unite with the silver of the spoon, and give rise to the disagreeable taste of the sulphuret formed on the spoon. Sulphur unites with iron at a *white heat*, and forms the sulphuret in a *fluid state*.

Sulphur is used in making *soda* from common salt. The fumes of sulphur are used in the process of bleaching silk; isinglass, straw-plait, bonnets, walnuts, &c. Sulphur is used in dyeing, and in making leather. Owing to its great inflammability, it is employed in making gunpowder, and lucifer and Congreve matches. Sulphur is also used in a liquid state, in taking casts of coins and medals, and other like objects. Flowers of sulphur, which is the product obtained by condensing distilled sulphur to a solid form, is used as a medicine, and in the preparation of vermilion, &c. *Sulphuric acid*, or oil of vitriol, is obtained by burning sulphur and some other substances which aid its combustion in furnaces made specially for that purpose. The sulphurous vapour combines with the oxygen of the air, and forms the acid or oil.

PLUMBAGO.

Adhe'res, sticks to.
Exhaust'ed, worked out.
Infe'rior, cheap.
Fric'tion, rubbing.
Sub'stitute, something in place of another.
Cru'cible, melting-pot.
Propor'tion, quantity.

Plumbago, or black lead, is a dark, leaden coloured mineral, of a dull, metallic appearance. It is smooth, and adheres to, and stains, anything it touches. It is insoluble in water, and infusible, but it burns slowly when subjected to a strong heat and a *current of air*. Plumbago is *found in Ceylon, the East Indies, largely in the United States*, and in Cumberland in England, where great quantities of it have been obtained, but the mine is now nearly exhausted. The Cumberland vein was about nine feet thick, and found between two beds of slate. Plumbago is composed of carbon and iron—9 of the former and 1 of the latter. It is used in making pencils, by being cut with fine saws into

slender, square columns, which are fitted into grooves cut in cedar wood. Inferior pencils are made of a mixture of plumbago and clay, or some other substances to cheapen them. Blacklead is used also in polishing stoves, grates, fenders, ranges, and other cast-iron furnishings. In a state of fine powder, it is used as a substitute for oil or grease, to reduce the friction of rubbing surfaces, as axles, slides, screws, and other things. The crucibles of gold and silver smiths are made of Stourbridge clay, and a small proportion of plumbago. This metal is a conductor of electricity.

SALT.

Support'ed, kept from falling.
Immen'se, very large.
Inflam'mable, able to be set on fire.
Ignite', set fire to.
Accu'mulated, brought into heaps.
Essen'tial el'ement, necessary article.
Ben'eficial, of much use.
Effec'tive, that does not fail.

Salt is a compound consisting of *chlorine* and *sodium*, 36 of the one and 24 of the other. It is found abundantly in most countries. It exists in small quantities in most of the waters in the world, and also in all soils. It tends to prevent decomposition of animal and vegetable substances. It preserves the ocean in a state fit for animal life, and it also forms a part of the nourishment of animals. The salt of the sea, if solidified, would form a bed 100 feet deep for every mile of its surface. Besides the sea, salt is obtained from springs, and in a solid state from rocks. There are two strata of rock salt in Cheshire, each 50 feet thick, filling a channel which once joined the Severn to the Mersey. The two strata are 31 feet and a half asunder. The rock is very hard, has to be blasted with powder, and is mined to a depth of 300 feet, the roof of which is 20 feet high, and supported by pillars of salt. There is a bed of solid salt at Northwich yielding 90,000 tons per annum. *Salt is found at Belfast*, and an *immense bed of* rock salt has lately been discovered at Middlesborough in Yorkshire. Salt is obtained in Galicia, Hungary, France, and Salzburg. There is a salt mountain at Cardova, or Cordova, in Spain, 300 feet high; and several are even still higher. There is a mountain in the Tyrol having a mine wrought in horizontal galleries, and salt mines exist in Peru 10,000 feet above the sea. A salt mine near Cracow extends a mile and a quarter in length, a quarter in breadth, and it has a depth of 750 feet. The whole mines here extend along in the form of large caverns several miles in length, supported by pillars of salt, and they have been wrought for twelve or thirteen hundred years. And there are extensive salt beds at Lake Inder, in Asiatic Russia. Salt beds overlie each other like coal, but lie in much thicker beds.

There are also many salt springs. Those at Droitwich, Worcestershire, contain 22 per cent of salt. Those of Cheshire as much. Those at Limeburg yield 25 per cent, or one-fourth of their weight, and send forth 75,000 gallons per day. There are

salt springs in China, near Thibet; and what is both strange and very convenient for the Chinese, is, that quite near them are found springs of inflammable gas, with which they evaporate the water of the salt springs, and obtain the salt. They dig wells, ignite the gas, put kettles full of the salt brine over the gas fires, and so procure the salt. As many as 300 kettles are heated at one gas fire.

Salt or sea-water is evaporated either by being boiled, or by the heat of the sun. Rock salt is purified by dissolving it, removing its impurities, and then evaporating the water. Water is a good solvent for salt. Five of the former dissolve two of the latter. Salt is accumulated by tides, or is the result of the evaporation of salt lakes. Salt is an essential element of the health and life of man. Digestion could not be carried on without it. It is also beneficial to domestic cattle, and many wild animals go great distances to obtain it in the pasturage of the sea-coast, at brine springs, or from the sea. It is used to cure or preserve fish and flesh meat, and to season most kinds of food. It is used as manure for some soils, and also to glaze coarse kinds of pottery-ware. It is used in chemical factories, and in alkali works for making washing soda. It is used as an effective emetic in cases of vegetable poisoning,—such as eating poisonous berries or roots, the dose being one or two large tablespoonfuls in a tumbler of water. It should be taken at once.

SODA.

Re'cent, not long ago. | Caus'tic, burning.

Soda is one of the fixed alkalies. Soda is a mineral alkali, potash being a vegetable one. The only other fixed alkali is *lithia*, but it is of recent discovery. There is but one volatile alkali, and that is ammonia, or hartshorn. A great deal of soda is found in many minerals, particularly in rock salt, and it is called, on that account, the mineral, or fossil alkali. But it can be obtained from vegetable substances as well, and for long its chief source was kelp, the ashes of burnt sea-weed. Soda is now prepared chemically from sea-salt, by adding oil of vitriol to it, and heating the compound with small coals and limestone. The soda is afterwards *dissolved in water*, and then crystalized. *Soda exists* in its ordinary state in large crystals, which are transparent and colourless, and contain more than half their weight of water. In dry air, the water evaporates, and the soda is left in a state of powder, and quite opaque. If the crystals are heated, the water contained in them will dissolve the crystals, and reduce the soda to a liquid state. More heat will evaporate the water, and leave the soda in the state of a dry, uncrystallized powder. Soda is soluble in water. It has an unpleasant, alkaline taste. It is a powerful solvent, causing the solution in water of dirt and grease. Quicklime increases this power by increasing its caustic quality. Chemically, soda is used in making both soap and glass. It is also used medicinally, but only in combination with carbonic acid.

GOLD.

Mal'leable, can be *hammered* without breaking.
Duc'tile, can be *drawn out* without breaking.
Alloys', mixtures of metals.
Tena'cious, can *support weight* without breaking.
Amal'gam, mixture of mercury with another metal.
Partic'ularly, chiefly.

Gold is a metal of a brilliant, yellow colour, and the only metal having that colour. It is very heavy, platinum alone exceeding it in weight, whilst it exceeds water by upwards of *nineteen* times its weight. It is very malleable when pure, for a *single grain* of it has been beaten out so as to cover sixty square inches, or 1,500 times thinner than ordinary writing paper; that is, 1,500 leaves of gold would be required to make a sheet equal in thickness to one of such paper; and a silver wire gilt with gold has been drawn out so as to reduce the gilding of the wire to the *twelfth part* of the thickness of the gold leaf so beaten out; but even this thinness has been surpassed in the gilding of earthenware, by means of a solution of gold. And to show its *ductility*, as well as its malleability, a single ounce of gold has been drawn out to the extent of 1,300 miles; but if the gold be alloyed with zinc this property will be destroyed. Gold is also very *tenacious*, for a wire, one-tenth part of an inch thick, made of it, will, without breaking, bear a weight of 500 lbs.; but an alloy of *lead* or *tin* will also destroy this property of gold. Gold unites easily with all the metals, and thereby its colour can be changed at pleasure, as for instance, to *green*, with 30 parts of silver, and to *red*, with 30 parts of copper. Gold *does not rust* or become *tarnished, even in* moist air, and acids fail to act upon it; but a mixture of two acids (muriatic and nitric), called aqua regia, (royal water), is effective in dissolving it. Gold is a *soft* metal, and alloys are necessary to harden it.

Gold is used largely for personal ornaments, as bracelets, rings, lockets, brooches, watches, and many other articles of jewellery; in making plate for the table, and in making coins as a medium of exchange. English coins are made of standard gold, which contains 22 carats, or parts, of gold, and 2 of alloy. This is valued at £3, 17s. 10½d. per ounce; but pure, or fine gold, without alloy, is valued at £4, 5s. 6d. per ounce Troy. Gold is also used to gild large articles, such as picture frames, the backs and edges of books, &c.; and also metal articles, by fixing upon them an electrical deposit of gold in a bath composed of a solution of that metal. This is called electro-gilding.

Gold is obtained nearly pure in the form of dust among the sands of some rivers; it is obtained in large and small pieces of the solid metal, called nuggets, some of them weighing many pounds. The largest nugget, called the Sarah Sand, weighed 233 pounds, and was valued at £16,000. Gold is often found mixed in hard, flinty rocks, called quartz. It is found in the Uralian mountains, California, Australia,—particularly at Bathurst and Ballarat

(the large nugget, "Sarah Sand," being got there), in North Columbia, on the Fraser River, in New Zealand, and in small quantities in Wales and Scotland. £15,000,000 of gold has been brought annually to the custom houses of this country for several years back, and in addition to this whatever may have reached the country through private sources.

When gold is found in the sands of rivers, the sands are *washed* to separate the gold; when found in a solid mass, it is *picked out* from the quartz rock; and when found mixed in the rock, the *rock is crushed* by machinery, *quicksilver* is added to the crushed rock, and it unites with the gold, and thus separates it from the rock: then the mercury is afterwards evaporated by heat, and the gold thus separated from the amalgam is left alone in the crucible or melting pot. The mercury does not unite with any of the rocky matter, otherwise the gold could not be obtained by its means. In Mexico, a different process from that of *evaporation* is adopted to remove the amalgam. The Mexicans put the united metals, gold and mercury, into skin bags, and press the mercury out through the pores of the skin by strong pressure. After the gold is freed from the amalgam in either of these two ways, it is put into crucibles and refined; that is, it is further separated from silver or other metals with which it may be combined in small quantities. These metals are, however, joined with it in small quantities.

SILVER.

Alloy', mixture of one metal with another.
Lus'tre, brightness.
Impress'ions, marks.
Retort', a vessel for heating substances.
Photog'raphy, art of making pictures by sunlight.

Silver is a metal of a pure white colour, brilliant when polished, and about ten times heavier than water. It has neither taste nor smell, nor is it acted on by either water or pure air, or the vegetable acids. If exposed to the action of sulphur, it becomes black, as when an egg is eaten with a silver spoon, the yolk containing and being coloured by sulphur. Decayed animal matter and coal gas also blacken it. Silver is *fusible*, but, like gold, is subject to no further change by heat. It ranks next to gold as a *malleable* metal, for it can be beaten out to a leaf of $\frac{1}{110000}$th part of an inch in *thickness. It is also very ductile, for it can be drawn out as* fine as a human hair, a single grain extending to 500 feet. Pure silver is soft, and it may, but not easily, be cut with a knife. It requires an alloy to harden it. The usual alloy is copper, and the quantity is one part of copper to eleven parts of silver for coins, and other articles. But this alloy does not change its colour or even its lustre.

Silver is found sometimes as an alloy, as a sulphuret, as an oxide, and as a salt. It is found in Saxony, Norway, Hungary, Spain, and America. It is found combined with lead in several of the mines of Great Britain, in the proportion of twelve ounces to a ton; and also as an ore combined with sulphur, &c.

Silver is separated from the other substances mixed with it by means of mercury. The ores are crushed, then mixed with mercury, which takes up the silver, and leaves the impurities, which are afterwards washed away. Then the amalgam is heated to drive off the mercury in vapour which is again condensed and collected for future use, leaving the pure silver behind in the melting pot. In Mexico the ores are crushed, then ground finely in a mill, whilst a mixture of salt and quicksilver is made with the powdered ores to form an amalgam. When the amalgam is completed, the mixture is washed to free it from earthy particles. After this the amalgam is filtered for two hours, and then moulded into bricks. These are placed in a retort and gently heated, when the mercury passes off in vapour and the silver is left alone in the retort. It is then melted in a furnace and run into moulds to form bars or *ingots*. Silver is used to make plate for the table, such as covers for dishes, candelabra, cruet-stands, tea services, spoons, forks, fruit and fish knives, &c. Being easily rolled into sheets and cut into any shape, it is very suitable, and has been used, for making coins, which receive and retain for a long time the impressions stamped upon them. It is used in plating other metals, or coating them with a covering of it. This is sometimes done by soldering thin sheets of silver to thicker sheets of copper, and rolling them out to any thinness required, as the two metals become proportionally thin without separating. United with nitric acid it is used by surgeons as a caustic, called *lunar caustic*, and this compound *dissolved* is used as marking ink, which very soon becomes dark by being exposed to the action of light. It is also used in the process of photography.

COPPER.

Sono'rous, loud-sounding when struck.
Sheath'ing, covering.
Li'able, subject to.
Mag'azines, store-houses.
Protect', guard.

Copper is a metal of reddish colour, brilliant when polished, and it has a disagreeable taste and smell when rubbed or slightly heated. It is very *malleable*, being easily worked by the hammer, and fit to be beaten out into thin leaves. It is very *ductile*, for it can be drawn out into fine wires; but gold, silver, and iron surpass it in this respect. It is also very *tenacious*, for a wire made of it, one-tenth of an inch in diameter, will, without breaking, support a weight of 175 lbs. Copper is very *flexible, and, in this* respect, it far surpasses iron, but it is *not* elastic in its natural state, but when hammered it becomes not only *very elastic*, but also *sonorous*, for then when struck it is one of the most loud-sounding of the metals. Copper melts at a red or white heat, and when in a fused state it is easily alloyed with other metals.

Copper is sometimes found pure or native in Siberia, in Sweden, and in the United States of America, but it is generally found in the state of an ore called copper pyrites, which is made up

of sulphur, copper, and iron in nearly equal parts. There are several kinds of copper pyrites, the most common of which being the yellow copper ore found in Cornwall, Devon, Anglesea, North Wales, Westmoreland, Cumberland, Lancashire, and the Isle of Man. The *black sulphide* and the *red oxide* are two of the most valuable copper ores found in England. Next to our own mines, the most valuable are those of Cuba and Chili, but a very valuable *ore* has been found in the Burra Burra mines of Australia. It contains no sulphur, and it has a greenish or bluish appearance.

Copper is separated from the other metals and substances in contact or union with it, by heating it to redness, or roasting it in an open furnace, to drive off the sulphur in fumes. After this, the ore is melted to separate it from other impurities, which are skimmed off from the surface of the molten copper, and this is repeated several times; but the Australian ore requires to be only once melted with coke, to yield the pure metal. Much of the Australian ore is melted in Wales.

Copper is used in making boilers, kettles, and scuttles, in sheathing the bottoms of ships to protect them from marine animals which adhere to them, the poisonous nature of the rust or *oxide* of copper preventing either plants or animals from attaching themselves to it. Copper is used in making coins, being easily cut or punched and stamped for that purpose by pressure. It is also used in making plates or rollers for engraving patterns and pictures on. It is used, drawn out in wire, for bell-pulls, being less liable to rust than iron is, and being soft and tenacious, and not liable to break easily. It is used also for telegraphic messages, being a good conductor of electricity. It is used instead of iron in powder mills and powder magazines, because it does not readily strike fire with grit or flint, being thereby less liable to cause an explosion of the gunpowder. Copper is employed in making several colours used by artists and painters. It is alloyed with *zinc* for brass, with *tin* for pewter and bronze, with *nickel* and *zinc* for German silver, and with *tin* and *lead* for solder. *One* part of copper, and *eleven* of gold, is the alloy for the *standard* gold of our gold coins. And it is used as an alloy to harden articles of plate. The alloy called *bronze*, which consists of *nine parts* copper and *one part* tin, is very hard; and, before iron was known and used, bronze was employed to make cutting instruments and warlike weapons. It is thought to have been the "brass" of Scriptural times and history. Modern brass is a mixture of copper and zinc.

IRON.

Expan'ds, becomes larger.
Vari'eties, kinds.
Unsuit'able, not fitted.
Pure or native, not mixed with other substances.
Impell'ed, driven or forced.

Iron is a fibrous metal, of a *grey-ish, white, or black colour*, brittle, *fusible, and, like water*, expands on passing from the fluid to the solid state. It exists in the three states of cast-iron, wrought-iron,

and steel. There are three varieties of cast-iron, the white, the grey, and the black. White cast-iron is very hard, brittle, and unsuitable for many purposes. Grey cast-iron is much finer grained, harder, and stronger than either the white or the black, and is generally used, especially for castings requiring strength. Black cast-iron is cross-grained and soft. Cast-iron is a combination of iron and carbon—not the pure metal. The tenacity of cast-iron is not great; it is too brittle to be very tenacious, but it is capable of resisting pressure to a very great extent. A square inch of Staffordshire iron will bear across the fibre without breaking a pressure of upwards of twenty tons.

Iron is seldom or never found in a pure or native state, yet it is the most generally diffused of all the metals. It is found in a state of combination with many other bodies, and in this state, it is called *ore;* but the most common, as well as the most profitable, is the *clay-ore*. This ore is found in large quantities in Staffordshire, Shropshire, Derbyshire, Wales, and the south of Scotland; in Sweden, and the United States of America. About a third part of the whole iron made in this country is produced by each of the three divisions, Wales, England, and Scotland. Recently a very valuable ore has been found in the shape of fine black sand on the beach of Taranaki Bay, New Zealand. It is found very suitable for making steel. In making or preparing iron, the ore is roasted to drive off the sulphur contained in it. It is sometimes roasted in kilns, but more frequently in the open air, where *alternate layers of* the ore and coal are piled up into a large heap and burned. When the ore has been roasted, it is put into a large conical shaped furnace about 60 feet high, along with an equal quantity or weight of coal or coke, and some limestone in proportion to the metallic value of the ore, and there subjected to continual blasts of *hot* or *cold* air impelled through the mass by immense steam power. Coal is used for common iron, but for iron of a superior quality, charcoal is used instead of coal or coke. The oxygen in the blast-air combines with the coke or charcoal, and the lime combines with the clay or earthy matter, leaving the metal free and in a melted state, and, being in this state heavier than the earthy materials lately in combination with it, the metal runs down to, or subsides at, the bottom of the furnace, the earthy materials float on the top of the molten metal in the form of slag, and when run off and cooled, have a glossy conglomerate appearance. The iron is run off morning and evening, through a hole at the bottom of the furnace into grooves made in sand on the ground in front of the furnace, where it is allowed to cool. The bars are about a cwt. each, and are called "pigs." This hole is always plugged up with wet sand or fire-clay when the iron is being made, and the sand is punched out when the iron is to be run off. The pig-iron is not pure iron, but a compound of iron and carbon. The iron in this state is now said to be made, and is ready for the founder, the puddler, or the maker of steel. Iron was smelted in Britain in the time of the Romans. In the reign of Edward III it was so dear that the king considered the pots and pans as part of his jewels.

WROUGHT-IRON.

Convert', change.
Inten'se, very strong.
Suffi'ce, to be enough.
Grad'ually, by degrees.
Redu'ce, make less.
Dimen'sions, measurements.

Wrought-Iron. — In order to convert "pig" into malleable iron, it must be freed from much, or nearly all of its carbon, just as the *ore* was first freed from its sulphur in roasting, and from its earthy companions in the process of melting. This is done by melting it in fining furnaces, by means of intense flame and strong air blasts. About two hours suffice to free it from most of its carbon, which is thus burned away, and the melted metal is run from the furnace into moulds, from which it is emptied into troughs of water, which cools and hardens it, and makes it become very brittle. The iron is not yet quite freed from carbon. To remove what yet remains combined with it, the moulded pieces are broken up into portions of about 4 cwt. each, and placed in the *puddling* furnace, where they are subjected to the action of an intense flame, which is made to pass over and around the pieces. This melts the iron again, and a workman, called a puddler, stirs it up in the furnace, so as to let the flame act on every portion of the iron, and burn the carbon out of it. When the iron is thus pretty well freed from carbon, it becomes thick, is taken out of the furnace, and beaten with heavy steam hammers; after which, but still at a red heat, it is rolled between rollers, the spaces between which gradually become less, and thus reduce the dimensions of the mass of iron, until it becomes a long bar.

The bars thus made are cut into smaller bars by steam wrought shears, and piled up upon each other, heated again, and again rolled as before. These bars cut into the length required, are now fit for the smith, and are tough and *malleable*. Instead of being cut thus finally into bars, the pile or mass of heated bars is often rolled out into broad sheets suitable for boilers, rails, the tires of wheels, &c., and these are often forged into large masses for shafts, and the large beams required for steam engines and other machinery.

STEEL.

Selec'ted, chosen.
Homoge'neous, all of the same kind.
Meth'ods, plans.
Cru'cible, heating or melting-pot.

Steel is made sometimes directly from pig-iron, and sometimes from wrought-iron. In either case the best iron is selected. *Iron from Dannemora, in Sweden, is preferred, as being by far the best; but iron* made from the black sand of Taranaki Bay, is said to make good tough steel, and of the finest quality. The processes pursued in making steel from pig-iron, and from wrought-iron are very different. In the former case the iron requires to

be *oxidized*, that is, combined with oxygen, and *decarbonized*, that is, deprived of the carbon it received from the coal or coke used in the process whilst it was being made in the furnace. To do these two things, the iron is heated till it is red hot, and then it is subjected to the action of the air; or, when at the point of melting, a blast of air is directed upon it. The use of a blast of air is the **Bessemer process.** By either of these processes the carbon is taken up by the oxygen of the air or blast, and carried off from the iron. In the latter case, the wrought-iron requires to be carbonized; that is, requires carbon to be added to it, as it was totally deprived of carbon in the processes of making it malleable. This is done by adding to the iron when at the fusing or melting point, either a quantity of solid carbon, or a quantity of gaseous carbon. This process has been called *cementation*. It is literally a process of stewing iron with carbon, as is done in making Damascus steel. To make it, a quantity of iron, and about the tenth part of that quantity of charcoal or dried wood, are placed in a crucible, and subjected to the required heat. Steel produced by either of these methods, and from either of these two states of iron, is not homogeneous, but crystalline, and to change it from the latter to the former, a process of *fusion*, or of forging, welding, or rolling it, is required. Produced by the first method of fusion, or melting, it is called "**cast-steel**," but by forging, welding, or rolling, it is called "**shear-steel.**"

CAST-IRON.

Surpass', to excel or be better. | **Mar'iner**, sailor.

Cast-Iron.—*Pig-iron* is used for *re*-melting in foundries, to be cast into all kinds of machinery and ironmongery, into water-pipes, gas-pipes, pillars or columns, beams, and girders for the walls and floors of houses. Nothing can surpass cast-iron in resisting any amount of downward pressure, as it does in the walls and floors of buildings, but the lower requires to be the stronger side.

Wrought-iron is used in making the chains, rods, girders, and riveted sheets of both suspension and railway bridges, but, unlike cast-iron, the upper requires to be the stronger side, to resist compression. Rolled into sheets, and wrought into rivets, it is used for *steam boilers; and in thicker masses it is used* for nearly all the parts of steam engines. It is used in making chain cables and anchors for ships, shoes and nails for the feet of horses, locks and keys for the doors and gates of houses, for boxes, and many other things, and all the varied articles of the smithy. It is also used as the stock metal of white iron, employed so largely by the tinsmith. This is made by dipping thin sheets of wrought-iron into a bath of melted tin, which keeps the iron from rusting. *Cast-steel* is used for railway carriage wheels, axles, guns, and bells, but *shear-steel* is used for springs, and all kinds of cutlery. Steel, either *cast* or *shear*, is used for workmen's tools of all kinds, and of all trades, for all kinds of cutting instruments used by all

people. Made *elastic* by tempering it in a peculiar manner, it is used as springs for carriages, for clocks, for bells, for locks, and other purposes, such as swords, &c.; and made *brittle*, also by tempering it in a peculiar manner, it is used for making razors and pen-knives, saws, &c. Made sufficiently *magnetic*, it is used in the mariner's compass, pointing to the poles, and directing the mariner in crossing the boundless ocean.

Iron is used medicinally in various forms and preparations: as a *tincture*, of muriate of iron, sometimes called "steel drops"; as a *carbonate* and *sulphate* (both salts of iron, the one being made up of carbonic acid and iron, and the other of sulphuric acid and iron). Iron is a necessary ingredient of the red blood of all animals, and its effect on man is to give *tone* to the muscles, and strength to the whole body. Iron is used in nature's laboratory as a dye-stuff or dyeing material in colouring gravel, sand, and clay; and it is used in the laboratory of man also for the purpose of dyeing colours, particularly *black*, and in the making of *black* ink for writing. For this purpose the sulphate is used.

SOAP.

Com'bination, mixture.
Procu'red, got.
Compo'sed, made up of.
Pecu'liar, singular, odd.

Soap is a combination of oil, fat, or tallow, and soda quickened by being boiled in newly burned lime to make it more caustic. Soda thus boiled with lime is called ley, or lye, and is used by all soap-boilers. Soda is a mineral alkali, and is procured from the ashes of wood, dried plants, or barilla. Kelp was formerly used. Hard soap is composed of tallow or oil, and soap boilers' ley. Common soda is not caustic enough to be used by itself along with oil or tallow, hence the addition of lime to increase its caustic quality. In England whale oil and tallow are used with soap boilers' ley, and some resin to colour the soap yellow. The peculiar smell and bitter taste of soap are caused by the resin, which also makes the soap more soluble than it would be without the addition.

MOTTLED SOAP, &c.

Fre'quently, often.
Uni'tes, joins with.
Vis'cid, sticky.
Vir'tue, strength or quality.
Unc'tuous, greasy.
Neu'tralize, destroy the power of.

Mottled Soap.—A quantity of melted tallow and kitchen grease is put into an iron vessel which is heated by fire or steam, and a quantity of ley is also poured in. *This compound is boiled for some time, during which process it is frequently stirred.* During the course of this operation, the tallow unites with the soda in the ley, and forms a liquid of a viscid quality. A strong solution of salt is added, and this separates the water from the ley, when the water is carried off by means of a pump. Fresh ley

is then added, when the mixture is again boiled, and salt afterwards added a second time, and the water thus separated is again pumped away: and so on, these processes being repeated until the whole quantity of tallow or grease is taken up by the soda, and thus the whole quantity of the mixture is made into soap. Then a small quantity of a solution of iron is sprinkled upon the surface of the soap liquid. The iron thus sprinkled sinks to the bottom of the liquid, and colours, or mottles the soap, giving it a marble streak as it passes downwards. The soap is then lifted out of the boiler into large pans to cool. When quite cold it becomes solid, and is then cut into bars by means of wires.

Curd, or white soap, is made with pure white tallow, and ley. No grease is used, or other impure tallow or oil.

Windsor soap is simply pure soap scented, and cut into small cakes.

Soft soap is made with pearl-ash or potash; and whale-oil, or sometimes seal-oil, is used along with the tallow.

Soap is soluble in water, the solution being semi-transparent, and it renders dirt or grease soluble also; hence its virtue as a washing material. Soap when moist has the quality of being unctuous. As already stated, soap causes grease or dirt to dissolve in water, being itself soluble, and without corroding or destroying cloth or any substance with which it comes in contact. The alkali, soda, made caustic as above, would, without being united to the tallow or oil, *cleanse more quickly* and powerfully, *but it would* do so to the injury, or even destruction of the cloth or other material to which it might be applied, just as bleaching and washing powders do. Soap was formerly much made from *kelp*, or the ashes of sea-weeds dried and burned in pits, and of oil or tallow; but kelp for this purpose has been superseded by the ashes of *barilla*, several marine plants growing on the eastern shores of Spain.

The best soap is made of olive oil and soda, in the southern countries of Europe.

Hardness in water is caused by sulphate of lime being in it; and soap being made of oil and soda, the sulphuric-acid, or oil of vitriol, in the water unites with the soda in the soap when a piece of soap has been dissolved by rubbing it in the water, then the oil of the soap and the lime of the water form cloudy flakes which may be seen floating in the water. Hence soap is a test of the sulphate of lime being in water. Boiling does not soften water in which there is sulphate of lime. Muriatic-acid in sea-water produces cloudy flakes in the same way. If the hardness of water arises from the presence of *carbonate of lime* or chalk, the water may be softened by boiling. Boiling causes the carbonic-acid in the lime to unite with the oxygen of the air, both being put into action and set free by the application of the heat necessary to boil the water; when they ascend into the air, and the neutralized lime falls by precipitation to the bottom of the vessel in which it has been boiled.

Ashes of wood, or barilla, and Dantzic ashes, or pearl ashes, will neutralize sulphate of lime in water. Any one of these will unite with the sulphuric-acid of

the lime in the water, and separate the acid from the lime, which then falls down to the bottom, or subsides.

A solution of the *sub-carbonate of potash* is in a large number of instances used by chemists to evaporate lime from water.

PENS.

Immer'sion, dipping or plunging.
Pun'ched, bored.
Impres'sed, stamped.
Revol've, turn round.

Pens. — Steel-pens are made chiefly at Birmingham and Sheffield. They are made of the best cast-steel, chiefly by the hands of women and the aid of machinery; but the tools required are made by men.

The steel in a soft state is rolled into stripes of the necessary breadth and thinness. They are then cleaned by immersion in a bath of a weak solution of sulphuric-acid, and put into a press and cut into pieces of the size of the pens to be made. The centre hole is then punched, and the name of the maker impressed on them. The next thing is to curve the nib, if a nib only is to be made, or to curve the cylinder if a barrel-pen is to be made. The nibs or the cylinders are then hardened by first heating them and then dipping them quickly in cold oil. After this they undergo a process of tempering to make them elastic; and, when this has been done, they are put into barrels containing fine sand, or other substance suitable for polishing, and the barrels are made to revolve, when the friction thus caused gives them a good polish. When taken from the polishing barrel the nibs are ground to a fine point on a stone or wheel with emery. The next thing is to cut the slit by means of a fine-edged chisel in a screw-press, and after this has been done they are coloured, and then varnished.

QUILLS.

Univers'ally, by every one.
Superse'ded, come in place of.
Sor'ted, put in different lots.
Reck'oned, thought.

Quills.—Quills are also used as pens for writing. They were universally used before the invention of steel-pens; but now steel-pens have nearly superseded them. They are got from the wings of geese, large flocks of which are kept in the fens of England, and also from swans. Quills are plucked from the wings of the geese, and then sorted; the *larger ones, and those* finer in *quality being put into* bundles of *twenty-five each,* and tied up; and the smaller ones, called *pinions,* are also tied up in bundles of an equal number. They are dressed, and sometimes stained. Many are brought from Russia, from Canada, and from the territories of the Hudson's Bay Company. Those from the Hudson's Bay territories are reckoned the strongest.

A quill is made up of two bundles of parallel fibres of a horny substance. The one bundle has the fibres placed parallel with the

length of the quill like the staves of a barrel; and the other has the fibres bound round the others in a circular form, like hoops, evidently to increase their strength. Hence, in making a quill into a pen, if a slit is made in the back of the quill, and in the direction of its length, the slit will have a ragged torn appearance, which will prevent the ink flowing from the pen in a clear, smooth line; but if the outer fibres are first scraped off with the pen-knife, then the slit made will be clean, close, and smooth, and the line written will correspond thereto, the ragged edge disappearing.

GLASS.

Occa'sionally, sometimes. | Fu'sion, melting.

Glass.—Glass is made of sand and potash or soda. The sand must be pure, and quite free from any tinge or taint of colouring matter, otherwise the glass will also be tinged or coloured. The best sand for making glass is got from Lynn, in Norfolk; from Alum Bay, Isle of Wight; from Aylesbury, Leighton-Buzzard, Reigate, and St. Helen's. Much fine sand is also got from America. Red-lead and litharge are also used in making some kinds of glass, to make it more fusible and more tenacious in the melted state; but they also make it more soft, and more susceptible of being scratched. Small quantities of manganese, arsenic, borax, and other minerals are used occasionally to increase the process of fusion, and to remove colour. A large quantity of broken glass, called *cullet*, is also used. Lime is used instead of a dearer alkali for the coarser kinds of glass. Glass is made in large quantities at Newcastle, at Bristol, at Glasgow, at Birmingham, and at St. Helen's; as also at Shields, Leeds, and London.

PLATE-GLASS.

Blends, mixes.
Ca'pable of, able to.

Oc'cupies, takes up.
In'dicates, shows.

Plate-glass is made chiefly at Newcastle and at St. Helen's, in this country, and at Paris, in France. The materials of which plate-glass is made being very white, sand, soda, lime, manganese, cobalt, and broken plate-glass, are ground very fine and sifted, and then they are most intimately mixed together in a revolving barrel, which, turning slowly, blends the ingredients closely together, as that is of the *greatest importance*. This mixture *is sometimes* heated slowly to melt and bring the mass into a pasty consistence. This is called *frit*. At other times this powdered mixture is melted in large pots at once, without being made into *frit*. But if first fused into frit, then the frit is melted in the large pots. These pots are made of a kind of clay, which is very infusible, and got from Stourbridge. Each pot is capable of holding about fourteen hundred-weight of melted glass. The pots are built into a furnace, dome-shaped, and having open-

ings in the sides. About nine hundred-weight of the powdered mixture is put into a pot at one time, and as it melts an equal quantity is again put in, and a third time more is added to fill up the pot. The molten glass thus occupies just about half the space that the powdered mixture occupied. About forty-eight hours, or two days and two nights are sufficient to bring the glass into a state of complete fusion. It is then allowed to fine, that is, to *settle*, by which all the heavier particles fall to the bottom, and any air contained in the mass rises in air-bubbles to the top, and escapes at the surface. The glass is then made and ready for use, to be blown or worked into any form or shape, and into articles of any kind. The glass in a perfectly fused state is poured upon an iron table, and a piece of iron fixed at the sides of the table indicates and regulates the required thickness. Then a metal roller is passed over the molten glass, and presses and flattens it down to the thickness of the metal strips at the edge of the table. It is put through a process, continuing several days, to anneal it. After it is annealed the plate is put upon a table and fixed firmly to it, then it is ground quite level, powdered flint being used with water for that purpose. The grinding is again repeated, with powdered emery, and after that it is rubbed with a woollen rubber and a polishing powder, and this completes the process of making plate-glass.

FLINT-GLASS.

Allow'ed, permitted or let.
Grad'ually, slowly.
Preven'ts, checks or hinders.
Effec'ts, causes.

Flint-glass is made of pure sand, washed and roasted, or calcined, of litharge, and of purified potash, in the proportions of 100 lbs., 70 lbs., and 30 lbs. of the three separate ingredients. A little saltpetre or arsenic is added to remove any colour attaching to any of the ingredients, and to leave the glass quite pure. These ingredients, when properly fused, are made, or blown through a long tube, and by means of some other simple implements or tools, into many kinds of articles for household use. Glass is so soft, ductile, and tenacious, that it can be blown, drawn, pressed, or moulded into any form or shape. The blower dips his tube into the glass in the melting-pot, and takes up as much as will make the article he wants to make, and he blows through the tube, and thus makes the glass at the other end of it hollow. It is then placed in the mould and pressed, or is rolled out, or twisted into the particular shape or form the article is to be made to assume. These articles are then annealed, that is, they are placed in an oven, heated to a high degree, and then allowed to cool gradually. This prevents sudden changes of heat or temperature from making them crack. The slow process of cooling effects this. To describe, however, the various operations of making the articles of flint-glass manufacture would be almost impossible. These operations are varied to suit the tastes of society.

CROWN-GLASS, &c.

Assu'me, take.
Ul'timately, in the end.
Expand', grow larger.
Imparts', gives.
Ex'quisitely, exceedingly.
Brit'tle, easily broken.
Lus'trous, shining.
In'corrodible, cannot be eaten into.
Imper'vious, not letting in.
Disper'se, scatter.

Crown-glass is made of sand and soda, or the ash of soda, and a small quantity of manganese, arsenic, and borax. These are exposed to a moderate heat for four hours, and thus fused into a soft paste or *frit*. The frit is afterwards melted, and skimmed of any saline matter that rises to the surface. Then a large quantity of *cullet* or broken glass is added, and this is left to fuse for forty hours, when it is ready for use. These materials, in the absence of any preparation of lead, require a much greater degree of heat to melt or fuse them. The blower dips his long iron tube into this molten mass, and lifts up ten or twelve pounds weight of fused glass on the end of it, and blows it into a large hollow shape, like a pear. He then presses the end against a flat surface, which makes it assume a circular form, with the end of the tube still sticking in the centre of it. An iron rod, called a *punt*, is dipped into the melted glass, taken out, and then stuck to the centre of the flat circular portion of glass opposite the end of the tube. Then the tube is detached by wetting the glass close to the end of the tube, when it breaks off from the glass, which is then left sticking to the *punt*. The punt, with the glass on the end of it, is then carried to a furnace and exposed to a great heat, and then it is twirled round, slowly at first, but afterwards at a great speed. This causes the hole left by cutting away the tube to become larger, and ultimately to expand so much as to become a plane surface, four or five feet in diameter, and of uniform thickness over all but the attached centre portion. This thick part is called the *bull's-eye*. The glass is then annealed, and afterwards divided into two disks, half circles or parts. This crown-glass is used for windows.

Dark green bottle-glass is made of river sand, soap-boiler's waste, which consists of lime and a small quantity of alkali, and without the use of any kind of lead.

Glass is coloured by adding some mineral substance to the glass in a fused state. Thus, soot imparts to glass a yellow colour; copper, a red tint; cobalt, a blue colour; iron, a green colour; tin, an opaque white; manganese, an amethyst; and gold, a ruby tint of an exquisitely beautiful shade.

Solid glass is beautifully transparent, hard, brittle in the mass, but elastic in fine threads, very compact or void of porousness, lustrous, insoluble, and incorrodible even by the strongest acids, susceptible of the highest polish, impervious to wind and water, but admitting the light and heat of the sun without interruption.

The uses of Glass.—Crown glass is used for windows, green, coarse glass for bottles; flint glass for a great variety of household articles—for gas globes, lenses for telescopes, microscopes, and spec-

tacles; these either collect the rays of light or disperse them, according as the glass is ground to a concave or a convex form.

Plate glass is now used largely for large shop windows, and also for all kinds of mirrors. For these purposes it is silvered with mercury.

PARCHMENT.

Du'rable, lasting long.
Man'uscripts, *written* papers.

Ex'tant, now in existence.
Acqui'red, attained or reached.

Parchment is prepared skins of sheep and goats. It is a very durable material for writing on, and it has been used for that purpose from a very early period. The earliest manuscripts in our possession are parchment writings, and the oldest copy extant of the New Testament is a parchment copy written during the middle of the fourth century.

The skins are soaked or steeped in lime water, which loosens the wool or hair, and cleanses the skin from all greasiness. The wool or hair is then scraped off the skins, which are stretched tightly across a frame made of wood, or across a large hoop. The skins are then pared down straight and even on both sides, and then well rubbed with pumice-stone, and allowed to dry. This latter process is repeated till the skins have acquired a degree of smoothness sufficient for writing on with ease.

Parchment is used for legal documents, such as deeds, leases, indentures, &c. It is used for drum-heads, tambourines, binding books, and for luggage labels. It is much stronger than paper, and is not so liable to suffer injury from dampness. Hence its use for these purposes.

LEATHER.

Inju'rious, hurtful.
Nu'merous, many.

Soak'ed, steeped.
Infe'rior, of less worth.

Leather is the tanned hides of animals. It is made of the skins of animals by a process of tanning. Tanning prevents the decay of the skins, which without tanning would soon become useless, and even injurious. When taken from the animal the skin is soft and moist, and when dried becomes brittle, cracks readily when bent, and soon decays, but especially if moist or wet. In that state they would be of almost no use. But when tanned the leather is still *soft, is flexible* or easily bent in a *dry as well as in a wet state*, and *it is impervious to water*, or water-proof, and possesses to a large extent the quality of durability. It is not heavy, and wears well when made into boots or shoes, harness, travelling-bags, and other things too numerous to mention.

The skins received either fresh from the butcher, or salted when imported, are scraped clean from bits of fat or flesh adhering, and then soaked in lime water to loosen the hair, which, after having been so steeped, is easily scraped off. The skins are then soaked in an acid liquid to open the pores of the skins, and make them better fitted to receive

the tan in the next process. This acid liquid is made by throwing barley or rye-flour into water, and letting it stand till it becomes sour, or by throwing in a small quantity of the oil of vitriol. The skins are now ready for the tan-pit. They are accordingly removed to it, and steeped in a weak solution at first of oak-bark and water, and afterwards in a much stronger solution. The skins are allowed to lie in this solution in the pits from six to twelve months, and sometimes even longer. If not allowed to remain long enough in the pit, the centre fibres of the skin will not be sufficiently tanned. After having been properly tanned, the leather (for the skins have now become leather) are removed and dried, and then rolled between rollers to make the surface smooth, and to press the fibres firmly together.

Leather is sometimes tanned by the aid of steam. This is called the "hot process." Tanning by this process is both quicker and cheaper, but the leather so tanned is greatly inferior in quality. Besides being tanned, leather is *curried* when required for the uppers of boots and shoes. The currier gets the tanned hides, pares them and rubs them, so as to make them thinner, softer, more flexible, and more capable of receiving a good polish; and he dyes them with lamp-black and oil, or lamp-black and tallow. The skins of calves, cows, and horses are thus curried; but the soles of boots and shoes are made of the thicker skins of oxen and some other animals without being curried.

MOROCCO LEATHER, &c.

Adhe'ring, sticking to. | Astrin'gent, binding.

Morocco Leather is made of the skins of goats. The hair is scraped off the skin or hide, and all particles of flesh adhering to it, and the skin is then sewed at the edges so as to form a bag, which is filled with water into which some sumach is put. This substance is astringent, and tans the skin in the same manner as oak-bark does; and the tanning is effected in a few hours. The skins are afterwards dyed and rolled between two grooved rollers which rub the skin, and give it the beautiful nappy appearance morocco leather always has. Morocco leather is very soft and flexible, and its nappy appearance and bright colours render it very suitable for many ornamental purposes. It is used in binding books, covering chairs, and the seats and linings of carriages and cushions, and other things.

Roan is made of sheep skin, and in the same way as morocco leather, and so as to form an imitation of it.

Wash or Shammy Leather is made of sheepskins. The skins are cleansed with lime, and dried. They are then wet with oil, and beaten with hammers; and this process is often repeated before the skins are considered soft enough. The oil or its excess is removed by an alkaline bath consisting of a solution of pearl-ash in water. After this the skins are dried, and are ready for use. Shammy leather is used to polish metallic articles. It is also worn

as underclothing, being very soft and warm.

Lamb-skins are used to make fine gloves, called "kid gloves," and are very soft, flexible, and slightly elastic. They are also used in making ladies' shoes. These skins are tanned with alum, and eggs and flour are used to make the leather soft and elastic, but, as a result of this, the price is increased.

LEAD.

Frag'ments, broken or detached pieces.
Tar'nished, made black.
Susta'in, support or bear.
Un'iformly, all the same.
Aro'ma, fine smell.
Dimin'ish, grow less.
Du'rable, lasting.

Lead is found combined chiefly with sulphur, and this combination is called galena or glance. Galena is very peculiar in appearance, being very bright, of a bluish white colour, brittle, and when broken, displaying fragments consisting of very small cubes. This ore of lead contains about eighty-five per cent of lead, and nearly fifteen per cent. of sulphur. It is found in great abundance in Derbyshire, Durham, Yorkshire, Northumberland, Cornwall, and Denbigh; and in less quantities in Shropshire, Staffordshire, Lancashire, Devonshire, and Westmoreland; also in the Isle of Man. It is found in Wicklow, Waterford, Lowth, and Tipperary, in Ireland; and in Dumfriesshire, Kirkcudbrightshire, Lanarkshire, and Argyleshire, in Scotland.

The ore is first picked, then washed, to separate it from other minerals, and to clean it. It is then broken into small pieces heated in an open furnace, where it is often stirred in order to let the sulphur burn away. The burned ore is then put into melting pots, and heated, when the lead melts and flows down to the *bottom of the vessel* or pot, from *which it is run off* into long *moulds, and in this* form it is called "pig lead." Lead, when clean cut, is of a bluish grey colour, and possesses a bright metallic lustre; but when tarnished by the air or water, it is of a dull grey colour, which is characterized as "lead colour." None of the common metals is so soft as lead. It will leave its mark if rubbed on paper; it may be scratched with the nail, or cut with a knife. Lead is very flexible, but it has no elasticity. It may be beaten or rolled into thin sheets, but these are not able to bear much strain. Lead may be drawn out into a wire less than the twelfth part of an inch in diameter, but this wire will not sustain a weight of more than the fifth part of a hundred-weight. Lead is very heavy; it is eleven times heavier than water. It melts long before it can be heated to redness. When melted, it absorbs from the air, and the product is an oxide in the form of a gray coarse powder, which floats on the surface of the molten lead. This oxide is first seen floating on the lead like a thin oily scum. This oxide or grey powder can be again reduced to the metallic state by heating it to redness.

Sheet lead is made in two ways. By one of these it is cast on sand,

and made uniformly thick by a *strike*, which is an instrument made of wood, and made to pass over the molten mass. Lead made in this way is called "cast" sheet-lead. Lead is also subjected to heavy pressure when in a cold state, by being placed between two steel rollers. When rolled out thus, the sheets are said to be "milled." The "cast" sheet-lead is inferior to the "milled" sheet-lead, being rougher, having more air-holes in it, being softer, and not so compact. Waste lead is generally used up by being cast into sheets. The sheets, both cast and "milled," vary in thickness, and are measured by the weight per square foot. Sheet-lead is used to cover houses, to make house gutters, house ridges, water pipes, and to line water cisterns. It is well fitted for these purposes, being soft, easily bent, cut, and hammered without breaking. Lead can be made into thin leaves. The Chinese make it into thin leaves like paper, by running melted lead into a stone, and pressing another stone on the top of it so as to squeeze it out into leaves of very great fineness. These leaves or thin sheets they use to line their tea-chests, to prevent the aroma of the tea from being evaporated.

Water-pipes are made by placing a steel rod in the centre of a hollow mould of cylindrical shape which is made to open and shut at the side; and then filling up the shut mould with melted lead which thus fills up the space between the mould and the steel rod, and thus the pipe is formed. When it becomes cold the mould is opened, the rod is withdrawn, and the pipe *is taken out; but in this state it is too thick*, as well as too short, so it is afterwards drawn out between rollers having circular grooves. The pipes are made to pass through a series of these grooves which gradually diminish, and so draw out the pipes by increasing their length, and lessening their thickness; and whilst this is being done, a rod is kept inside to prevent them closing up. Lead pipes are also drawn through a lessening series of metal collars to reduce their thickness, and to increase their length.

Lead is very poisonous, yet it is used daily for water cisterns and water pipes with perfect safety. The salts held in solution in the water prevent the rust of lead from being dissolved. If the water be very pure, or free from any kind of saline solution, it will dissolve the rust of the lead and become poisonous. Iron is more used now than lead for water pipes; it is safer with pure water, sweeter, and also cheaper.

Lead is used for making bullets for guns and pistols. It is cast in iron moulds. But elongated conical bullets used in connection with improved rifles are made by the compressure of powerful machinery on lead alloyed with a small portion of metallic arsenic. This alloy is melted, and poured into a kind of cullender, through the holes of which it flows, and forms drops as it descends from a great height into cold water. Shot is always cast from the top of a high tower, which is generally built on the bank of a running water or stream.

Printers' types are formed of lead and antimony. This alloy is much harder than lead, and is much more durable. The smallest

size of type require the largest quantity of antimony, and the largest, the smallest quantity.

Solder is an alloy formed of lead and tin. There are two kinds of solder—a coarse and a fine kind. The coarse kind is made of one part of tin and three parts of lead; and the fine kind is made of two parts of tin and one part of lead. Solder melts with less heat than either lead or tin, hence, a hot copper bolt which will melt the solder, will have no effect upon the lead or the tin to which it is applied. Lead is also one of the ingredients of some inferior kinds of pewter.

Litharge, red lead, and white lead, are preparations of lead; but black lead used in pencils is no combination or alloy of lead. It is iron and carbon.

EARTHENWARE, CHINA, &c.

Dis'integration, breaking into pieces.
Super'fluous, useless, more than enough.
Suspen'ds, keeps in solution.
Accom'plished, managed or done.
Bur'nished, polished.
Translu'cent, clear, transparent.

Earthenware, China, &c.—Earthenware is made of clay and flint. White clay is got in Dorsetshire and Devonshire. It brings a price as high sometimes as 23s. per ton. China, or porcelain, is made of China clay, a material obtained, under the name of *Kaolin*, from Dartmouth and St. Austell, the former in Devonshire and the latter in Cornwall. Granite rock is the source of its supply. It is supplied in the form of fine clay, by the process of disintegration of the rock. The decomposed rock is subjected to a process of washing, which suspends the fine clay in the water used, and the clay is afterwards procured in the mass by allowing it to subside in the water. This clay brings 20s. per ton. Stoneware is made of China-stone, a material got in the district of St. Austell. It is somewhat similar to China-clay, and brings the same price. The flints used are got in the districts where chalk is found in abundance, chiefly from Kent and *Wales, and some from* Ireland. *Staffordshire is the chief* seat of the manufacture. Coal is largely used in the various processes. The clay is put into water and stirred up by machinery to bring it to the thickness of cream, for a period of thirty hours or so. The flints are heated and brought to a state of redness, and then, to make them more brittle, they are cooled by sudden immersion in cold water. They are then forced or pressed through a fine grating, and afterwards ground in a mill made of *chert*, a hard flinty stone. The powder of flint thus got is also mixed with water, and brought to the thickness of cream, when it is allowed to stand till the heavier and coarser portion of it *settles* at the bottom. Then the two fluids are run into one, in the proportion of four or five of the clay to one of the flint. The combined fluid is then strained through a series of sieves increasing in fineness to keep back all gritty particles, and to mix the liquids thoroughly. After having been sifted the liquid is called *slip*. The water it contains is then evaporated by being boiled

away, and the flinty clay brought to a proper thickness or consistence. This is done in a kiln, and then removed to a place where it is allowed to lie for months, and sometimes years, as its quality is thereby improved, and its liability to crack removed. The next process it undergoes is that of *slapping*. This consists of cutting a mass of the clay in two and dashing the two pieces together with great force by a workman. This action is often repeated on a table, so as to drive off any air-bubbles contained in it, and make it compact or perfectly solid. It is now ready for being *thrown* or *moulded*. All round articles are thrown, and all articles not round are moulded. The man who throws them is called a *potter*, and he does it by means of a wheel. This wheel is in the form of a flat piece of wood, like a small circular table, resting upon an upright shaft, which is made to turn round by a cord and a wheel driven round by an assistant. A portion of the prepared potter's clay is put upon the centre of the potter's wheel which the assistant turns rapidly round, and the potter by using his fingers and thumbs forms the article to the required shape and thickness. The potter's fingers are applied to the outside, and the thumbs to the inside of the vessel he is forming. He does this very quickly, and, when finished, the wheel is stopped, the vessel is cut off close to the wheel by a fine wire, carried to dry, and another piece is placed on the wheel to be treated in like manner. When sufficiently dry, the articles made are turned in a lathe, to bring them to the exact shape required, and to make them quite smooth. This is done by the *turner, who holds a small piece* of thin steel or iron which shaves off the superfluous clay, and then the wheel is reversed, and the piece of steel is pressed upon the article whilst it is being rapidly turned, and it is thus made quite smooth. The handles and spouts are formed in separate moulds, and are fixed on by dipping them in *slip*, and attaching them and pressing them to the articles previously *thrown* and turned.

All articles not of a round shape, such as jugs, tureens, oval tea-pots, ashets, plates, saucers, and many other articles, are pressed into, or on to, moulds which are made of plaster of Paris. The clay is rolled out flat, and of the thickness required, cut into pieces of the proper size of the mould, and pressed into the corners of the mould by the fingers and thumbs. All flat articles, such as plates and saucers, are pressed on to a mould which shapes the inside, and the hand shapes or forms the outside of the articles which are then finished by turning as above. Very irregularly shaped articles are cast in dry plaster moulds, by pouring into them a quantity of *slip*. The mould absorbs the water of the slip, dries the clay in contact with the mould, and thus shapes and forms the article, and then the liquid slip is poured from the centre of the mould, and thus the article is left hollow.

All articles whether *thrown* or *moulded*, are dried in earthenware boxes called *seggars*, placed in the drying stove and baked, and afterwards heated to redness in a kiln for about two days and two nights. The articles have now arrived at their *biscuit* state, this term being applied from the process of double *baking*, which they have under-

gone. The articles are now hard, but very porous, and incapable of holding water for any length of time. To remove the porosity, and to make them impervious to water, they have to undergo the further operation of glazing. This is accomplished by dipping the *biscuit* ware into a liquid containing white lead, flint, and some other ingredients in small quantities, when a portion of the liquid covers and adheres to the articles dipped into it. The dipped articles are again baked in the glazing kiln or oven, and heated to such a degree that the glazing matter melts into a kind of transparent glass which is bright and shining, and entirely free from porousness. Patterns, when required, must be applied before glazing the ware. The colours are made into ink with oil, &c., and the design which has been printed from copper-plates on thin paper, is applied to the biscuit ware, and gently rubbed on and into its porous surface. The paper is afterwards washed away, and the colours dried before the articles are dipped into the glazing liquid.

China or porcelain is treated in much the same way; so is stone ware, and even red or brown-clay ware. The only difference in these consists in the different materials used. China is brought to its beautiful translucent state by heating it nearly up to the melting point, and the colouring of the patterns is painted in with manual labour, after the articles have been glazed. The oxides of several metals are used along with glass, nitre, or borax, to impart the colours required. Gold dissolved in aqua regia, and into which solution a bar of pure tin has been plunged, causes the precipitation of a purple powder which is sold at 35s per ounce; and is used as a purple paint for China ware. Oxide of cobalt produces a blue colour which can be shaded by the use of tin or zinc; oxide of iron produces a red colour; chromate of lead produces a yellow colour; and oxide of copper produces a green colour. The colours are fixed separately, and those which stand the greatest degree of heat are fixed first. Gold gilding is the last process. It is applied as a liquid; the ware is then baked, and the gilding finally burnished with what are called *steel burnishers*.

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